(*—*)

REVISED WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

LOWER CLEAR BOGGY CREEK WATERSHED

ATOKA, BRYAN, COAL, AND JOHNSTON COUNTIES, OKLAHOMA

PREPARED UNDER THE AUTHORITY OF THE WATERSHED PROTECTION AND FLOOD PREVENTION ACTS, (PUBLIC LAW 566, 83rd CONGRESS, 68 STAT. 666), AS AMENDED.

Prepared by: Atoka County Soil and Water Conservation District
Bryan County Soil and Water Conservation District
Coal County Soil and Water Conservation District
Johnston County Soil and Water Conservation District
Lower Clear Boggy River Conservancy District
Oklahoma Tourism and Recreation Department

With Assistance By:

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

May 1973

4-17920 REV 5-73
USDA SCS-FORT WORTH, TEX. 1973

REVISED WATERSHED WORK PLAN

435713

(*__*)
100

REVISED WATERSHED WORK PLAN AGREEMENT

between the

Atoka County Conservation District
Local Organization

Bryan County Conservation District
Local Organization

Johnston County Conservation District
Local Organization

Coal County Conservation District
Local Organization

Lower Clear Boggy River Conservancy District
Local Organization

Oklahoma Department of Tourism and Recreation
Local Organization

In the State of Oklahoma
(hereinafter referred to as the Sponsoring Local Orgainzation)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, the Watershed Work Plan Agreement for Lower Clear Boggy Creek Watershed, State of Oklahoma, executed by the Sponsoring Local Organization named therein and the Service, became effective on the 6th day of March 1964, and

Whereas, in order to carry out the watershed work plan for said watershed, it has become necessary to revise and supersede said watershed work plan agreement; and

Whereas, a Revised Watershed Work Plan which modified the watershed work plan dated March 1964 for said watershed has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the revised watershed work plan and further agree that the works of improvement as set forth in said plan can be installed in about 8 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The relocation cost will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	52.97	47.03	36,000

2. Except as hereinafter provided, the Sponsoring Local Organization will acquire, without cost to the federal government, such landrights as will be needed in connection with the works of improvement. (Estimated Cost $602,996.) The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Landrights Cost (dollars)
Multiple-Purpose Structure No. 13 and Recreation Facilities:			
Payment to landowners for 2,840 acres	69.19	30.81	405,333
Legal fees, survey cost, and other	100.00	-	500
All other structural measures	100.00	-	197,663

3. The Sponsoring Local Organization agrees that all land acquired or improved with Public Law 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the operation and maintenance agreement.

4. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

5. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Multiple-Purpose Structure No. 13	9.19	90.81	337,000
Recreational Facilities	50.00	50.00	546,480
All Other Structural Measures	-	100.00	1,971,665

6. The percentages of the cost for engineering services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Cost (dollars)
Multiple-Purpose Structure No. 13	-	100.00	31,341[1/]
Recreational Facilities	50.00	50.00	49,000[1/]
All Other Structural Measures	-	100.00	225,176

1/ By A. & E. Contract

7. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be $22,200 and $119,374, respectively.

8. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm and ranch plans on their land.

9. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

10. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

11. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

12. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

13. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

14. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

15. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construec to extend to this agreement if made with a corporation for its general benefit.

16. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United

States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.

17. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Atoka County Conservation District
Local Organization

By Virgil P Hardin

Title Chairman

Date 11-13-72

The signing of this agreement was authorized by a resolution of the governing body of the Atoka County Conservation District
Local Organization

adopted at a meeting held on 11-13-72

W. T. Waggoner
(Secretary, Local Organization)

Date 11-13-72

- -

Bryan County Conservation District
Local Organization

By Troy A. Stone

Title Chairman

Date 12-14-72

The signing of this agreement was authorized by a resolution of the governing body of the Bryan County Conservation District
Local Organization

adopted at a meeting held on 12-14-72

Doretha Gordon
(Secretary, Local Organization)

Date 12-14-72

Lower Clear Boggy River Conservancy District
Local Organization

By Boyd Jones

Title Vice Chairman

Date 11-16-72

The signing of this agreement was authorized by a resolution of the governing body of the Lower Clear Boggy River Conservancy District
Local Organization

adopted at a meeting held on 11-16-72

Tom Faudree
(Secretary, Local Organization)

Date 11-16-72

Oklahoma Department of Tourism and Recreation
Local Organization

By [signature]

Title Chairman

Date 3/31/73

The signing of this agreement was authorized by a resolution of the governing body of the Oklahoma Tourism and Recreation Commission
Local Organization

adopted at a meeting held on 2/12/73

J E Carter
(Secretary, Local Organization)

Date 3-31-73

Johnston County Conservation District
Local Organization

By Victor Herron

Title Chairman

Date 12-13-72

The signing of this agreement was authorized by a resolution of the governing body of the Johnston County Conservation District
Local Organization

adopted at a meeting held on December 13, 1972

Paula Elrod
(Secretary, Local Organization)

Date 12/13/72

- -

Bryan County Conservation District
Local Organization

By Tracy A. Stone

Title Chairman

Date 12-14-72

The signing of this agreement was authorized by a resolution of the governing body of the Bryan County Conservation District
Local Organization

adopted at a meeting held on 12-14-72

Dorothy Gordon
(Secretary, Local Organization)

Date 12-14-72

REVISED WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

LOWER CLEAR BOGGY CREEK WATERSHED
ATOKA, BRYAN, COAL, AND JOHNSTON COUNTIES, OKLAHOMA

Prepared Under the Authority of the Watershed Protection and flood prevention Acts, (Public Law 566, 83rd Congress, 68 Stat. 666) as amended.

Prepared by

Atoka County Soil and Water Conservation District, Oklahoma
(Sponsor)

Bryan County Soil and Water Conservation District, Oklahoma
(Sponsor)

Coal County Soil and Water Conservation District, Oklahoma
(Sponsor)

Johnston County Soil and Water Conservation District, Oklahoma
(Sponsor)

Lower Clear Boggy River Conservancy District, Oklahoma
(Sponsor)

Oklahoma Tourism and Recreation Department
(Sponsor)

With Assistance By

U.S. Department of Agriculture, Soil Conservation Service

May 1973

4-17920 REV. 5-73

REVISED
WATERSHED WORK PLAN

LOWER CLEAR BOGGY CREEK WATERSHED
Atoka, Bryan, Coal, and Johnston Counties, Oklahoma
November 1969

SUMMARY OF PLAN

General Summary

The work plan for watershed protection and flood prevention for the Lower Clear Boggy Creek watershed, Oklahoma, was prepared by the soil and water conservation districts of Atoka, Bryan, Coal, and Johnston Counties, and the Lower Clear Boggy River Conservancy District as the sponsoring local organizations. The U. S. Department of Agriculture and the U. S. Department of Interior provided technical assistance.

The Lower Clear Boggy Creek watershed begins about six miles east of Wapanucka, Oklahoma, and includes all of the drainage area of Lower Clear Boggy Creek and its tributaries, except Caney Creek, down to a point 11 miles northwest of Boswell, Oklahoma. The drainage area comprises 240,301 acres (375.47 square miles). Approximately 7.0 percent of the watershed is cropland; 18.2 percent is native rangeland; 24.9 percent is tame pasture; 44.1 percent is pastured woodland; and 2.8 percent is pasture (former cropland). Three percent is in miscellaneous uses, such as stream channels, towns, and roads.

The flood plain of Lower Clear Boggy Creek and its tributaries is subject to frequent and severe flooding. Major floods covering more than half of the flood plain occurred eight times in 1945. There were six major floods in both 1942 and 1957.

The installation and operation of the project will reduce 35 of the 41 major floods, such as occurred during the 20-year evaluation period, to minor floods on the flood plain below structures. All flooding would be eliminated from 68 of the 137 minor floods. The flood threat will be eliminated from 4,975 acres. Reduced frequency and depth of flooding will make it possible for farmers to make more intensive use of the flood plain land.

The work plan proposes an 8-year period for installing the needed works of improvement at a total estimated cost of $6,678,588. The share of this cost to be borne by other than Public Law 566 funds will be $3,471,023, and the Public Law 566 share will be $3,207,565.

Land Treatment Measures

The cost for land treatment is estimated to be $2,735,356, of which $2,620,934 will be borne by other than Public Law 566 funds. The Public

Law 566 share, which consists entirely of accelerated technical assistance, is $114,422.

Structural Measures

The original plan, which was approved by the House Public Works Committee on October 8, 1963, and by the Senate Public Works Committee on March 3, 1964, included 37 floodwater retarding structures and outlet channels. The total estimated cost was $2,732,567, which included a Public Law 566 cost of $2,373,507 and other cost of $359,060.

The structural measures included in this revised plan consist of 27 single-purpose floodwater retarding structures, one multiple-purpose structure, recreational facilities, and outlet channels. The total cost of these measures is $3,943,232, of which the cost other than Public Law 566 is $850,089, and Public Law 566 share is $3,093,143. The local share of the cost of structural measures includes construction, engineering, land rights, project administration, and relocation.

Damage and Benefits

The average flood damage in the watershed is estimated to be $198,861. The average annual damage after installation of this project and planned upstream projects, including both land treatment and structural measures, is estimated to be $40,872. The difference of $157,989 represents an overall average annual reduction in flood damages of 79.4 percent.

Processors of agricultural commodities and other businesses in the area will benefit from the project.

The average annual primary benefits accruing to structural measures are estimated to be $331,729, distributed as follows:

Damage Reduction	$ 84,812
Recreation	185,418
Sediment Reduction to Boswell Reservoir	5,325
Changed Land Use	28,174
Redevelopment	28,000
	$331,729

Secondary benefits of $22,700 annually will result from the project.

The ratio of average annual benefits accruing to structural measures ($354,429) to the average annual cost of structural measures ($213,760) is 1.7 to 1.0.

Provisions for Financing Construction

The Atoka County, Bryan County, Coal County, and Johnston County Soil and Water Conservation Districts are legal subdivisions of the State of Oklahoma. Each has powers of eminent domain and the authority to use State revolving funds in watershed operations. Each soil and water conservation district, with the assistance of the Lower Clear Boggy River Conservancy District, will obtain easements within its own district and will provide for local installation costs by donation of land and other services, and by use of State, county, or local revolving funds.

Should funds obtained by the above methods prove to be inadequate, consideration will be given to additional funds needed and the method of obtaining them. The sponsors then may decide to apply to the Farmers Home Administration for these funds.

The Lower Clear Boggy River Conservancy District is a legal subdivision of the State with powers of taxation and eminent domain. Through its powers of assessment and taxation, the conservancy district will raise the additional funds. If a loan is obtained from the Farmers Home Administration, the conservancy district will use its powers to assure repayment of the loan.

Operation and Maintenance

Land treatment measures will be maintained by the landowners or operators of the farms on which the measures are installed, under agreements with the soil and water conservation districts. The 27 single-purpose floodwater retarding structures and outlet channels will be operated and maintained by the soil and water conservation districts jointly with the Lower Clear Boggy River Conservancy District. The Oklahoma Industrial Development and Park Department will operate and maintain multiple-purpose structure No. 13 and the recreation facilities. The estimated average annual value of operation and maintenance of the structural measures is $53,152.

DESCRIPTION OF THE WATERSHED

Physical Data

The Lower Clear Boggy Creek watershed, with a drainage area of 240,301 acres (375.47 square miles), includes the area to be inundated by the upper reaches of Boswell Reservoir. The watershed begins about 6 miles east of Wapanucka, Oklahoma, and includes all the drainage area of Lower Clear Boggy Creek and its tributaries, except Caney Creek, down to a point 11 miles northwest of Boswell, Oklahoma, some 31 miles downstream. The main tributaries of Lower Clear Boggy Creek on the north and east sides of the watershed are Fronterhouse, and East and West Caney Creeks. Its main tributaries on the south and west are Sandy, Salt, Davis, Cowpen, Long Branch, Cowper, Bois d'arc, Harrington Branch, and Shawnee Creeks.

The Clear Boggy River basin has been divided by local groups into six watersheds (figure 4). Lower Clear Boggy Creek includes the lower part of the watershed basin. An application for planning assistance for each of the watersheds was filed with the Department of Agriculture. The Upper Clear Boggy, Leader-Middle Clear Boggy, Delaware, and Caney Creek watersheds have been planned and construction is 70 to 80 percent complete.

Clear Boggy River has a total drainage area of approximately 1,000 square miles. It rises two miles southwest of Ada, Oklahoma, in Pontotoc County and flows generally southeast where it joins Muddy Boggy River. The Boswell Reservoir dam, a Corps of Engineers flood control project, was authorized in 1946. It will be constructed approximately five miles below the junction of Muddy and Clear Boggy Rivers.

The main stream flood plain of Lower Clear Boggy Creek ranges in width from 2,000 to 9,500 feet throughout the entire length of the flood plain.

The total flood plain of Lower Clear Boggy Creek and all its tributaries, not including 1,024 acres of stream channels and approximately 17,500 acres of flood plain inundated by Boswell Reservoir, is 22,010 acres. This area includes 17,684 acres below structures, 1,292 acres in and above structures, 2,759 acres on tributaries flowing into Boswell Reservoir, and 275 acres on small unprotected tributaries.

The mean sea level elevation ranges from 445 feet to 750 feet. The channel slope is about 2.0 feet per mile on the main stream, and ranges from 6 feet to over 50 feet per mile on the tributaries. The topography ranges from gently rolling to steep and hilly.

The exposed rocks in the watershed are sandstones, shales, limestones, and granites ranging in age from pre-Cambrian to Cretaceous.

The soils developed from sandstones are medium to coarse textured, permeable, and moderately productive. The soils developed from limestone and limy shales are dark colored, fine textured, slowly permeable, and very productive. Shallow and very shallow soils occur in some areas.

The flood plain soils are mostly dark, fine textured, slowly permeable, and very productive. They are of Recent age. A few small areas of high lying alluvium are Pleistocene in age.

Sediment production rates are low in the pasture and pastured woodland areas. They are moderately high in some areas of formerly cultivated land where gully erosion is severe.

Most of the watershed is in pasture and pastured woodland use. The hydrologic cover in this area is fair. Very little of the upland area is in cultivation. A small acreage (6,755 acres) of formerly cultivated land has a vegetative cover of annual weeds and grasses, low order perennials, and some desirable perennial grasses.

The land use in the watershed is:

Land Use	Acres	Percent
Cropland	16,880	7.0
Rangeland	43,760	18.2
Tame Pasture	59,700	24.9
Pastured Woodland	106,006	44.1
Pasture (Former Cropland)	6,755	2.8
Miscellaneous	7,200	3.0
Total	240,301	100.0

The watershed lies in the moist subhumid climatic zone. The average frost-free period of 229 days extends from March 26 to November 6. Mean temperatures range from 83.0 degrees Fahrenheit in summer to 40.0 degrees in winter. The mean annual temperature is 63.0 degrees Fahrenheit. The extreme recorded temperatures were 9 degrees below zero and 116 degrees above zero.

The average annual rainfall recorded at the Durant gage is 39.00 inches. The minimum of 22.26 inches fell in 1909, and the maximum of 64.73 inches was recorded in 1945. The Clear Boggy River gage, installed in 1942, has recorded annual yields from the watershed ranging from a high of 32.37 inches in 1945 to a low of 0.92 inch in 1956.

Thirty-five percent of the annual rainfall occurs in the months of April, May, and June. The remaining 65 percent is distributed rather uniformly throughout the other nine months, with the least in August. Flood producing storms of the advanced frontal type may occur in any month of the year, but they are most frequent during the spring months.

Water for livestock and rural domestic use is supplied from farm ponds, wells, and from stream and spring flow. Springs are scattered throughout the watershed. Several of the large springs have never been dry. In the southern areas, well water is obtained from limestones at depths of 50 to 200 feet. Most of the wells furnish sufficient water during years of

normal rainfall. Many ponds and wells do not provide a dependable water supply during periods of extended drouth.

Economic Data

The farm and ranch units in this watershed are mostly owner-operated and range in size from 40 to 6,000 acres. There are 1,424 farm and ranch units in the watershed. Of this number, 30 are over 500 acres in size. There is a marked trend in the watershed toward larger operating units and greater capital investments.

The soils of the flood plain are fertile and capable of producing a wide variety of crops. At one time most of the flood plain was cropped to cotton and corn, but frequent and severe flooding has caused the farmers of the area to shift to pasture and forage crops.

The average value of flood plain land is $150 to $200 per acre. The value of the upland ranges from $50 to $125 per acre.

Beef cattle is the main agricultural enterprise in the watershed. Most of the pasture has a good Bermudagrass base. Alfalfa, oats, Johnsongrass, and Bermudagrass are grown for hay. Alfalfa, big hop clover, black medic, white Dutch clover, fescue, and lespedeza all thrive on the bottom lands where there is less frequent flooding.

There are two incorporated cities in the watershed; Caney, population 128, in Atoka County and Caddo, population 814, in Bryan County.

Two grade A dairies operate in the watershed. One, a 200-cow registered Guernsey dairy, processes and retails its own milk in Atoka and surrounding towns.

The Oklahoma Industrial Development and Park Department is developing the Boggy Depot Reservoir and recreation facilities. Boggy Depot was established before the Civil War and served as a stage coach stop. It was also headquarters for the Chickasaw Indians. It is one of Oklahoma's most interesting and colorful historical attractions.

U.S. Highway 75, State Highway No. 7, and State Highway 48 cross the upper part of the watershed. State Highway 22 crosses the southern part of the watershed. Access roads in the watershed are inadequate as numerous section line roads are closed. Floods often block the existing roads. There are only four bridges across Clear Boggy in the watershed. One of these is on State Highway 7 between Atoka and Wapanucka, another on a county road east of Boggy Depot Store, a third on U.S. Highway 75 just north of Caney, and the fourth on the county road north of Matoy.

Railroad freight facilities are available at Caney, Tushka, and Caddo.

Land Treatment Data

The project area is served by four Soil Conservation Service work units located at Atoka, Coalgate, Durant, and Tishomingo. These work units are providing technical assistance to the soil and water conservation districts in Atoka, Bryan, Coal, and Johnston Counties. Through the district they have assisted the farmers and ranchers in the watershed in the preparation of basic soil and water conservation plans on 153,481 acres. Another 11,185 acres owned by district cooperators do not have basic plan agreements. The total area under agreement is 160,723 acres, which is approximately 67 percent of the total area of 240,301 acres. About 64 percent of the planned practices have been applied.

The Land Operations Work Unit office of the Bureau of Indian Affairs at Ada, Oklahoma, furnishes technical assistance to farmers operating 3,943 acres of Indian allotments within the watershed. This assistance is given through conservation plans and stipulations.

Minor efforts to reduce floods, such as leveeing and channel straightening and enlargement, have been made by individual landowners. The supervisors of the four soil and water conservation districts have been very active in soil and water conservation as related to flood prevention. They have used their influence to interest farmers, ranchers, and other groups in the watershed program.

WATERSHED PROBLEMS

Upstream projects on the Upper Clear Boggy, Leader-Middle Clear Boggy, Delaware, and Caney Creeks watersheds have been planned. Some segments are being installed.

Floodwater Damage

An estimated 22,010 acres of the watershed, excluding stream channels, is flood plain (figure 5). As described herein, the flood plain is the area that will be inundated by the runoff from a 24-hour, 25-year frequency storm. The flood plain is subject to frequent and severe flooding. Major floods covering more than half of the flood plain occurred eight times in 1945. There were six major floods in both 1942 and 1957. The frequency and severity of flooding is so great that the sum of the areas flooded during an average year is about 2.5 times the area of the flood plain. Summation of areas flooded, including those flooded up to 8 or 9 times a year, gives an average of 51,662 acres flooded annually.

Flooding is most common during the spring growing season. Owners and operators of the flood plain lands do not remember a flood-free year. The flood of December 11, 1946, covered all of the flood plain area. The channel capacity at Valley Section 11, the most frequently flooded point on the main channel, was exceeded 15 times in 1945 and 13 times in 1957. (figure 5).

The 20-year evaluation period, 1942 through 1961, was selected to represent normal rainfall and flood conditions. During this period, there were 41 major floods and 137 minor floods. Twenty-nine of the major floods and 71 of the minor floods occurred during the spring season and caused damage to growing crops. Four of these major floods covered over 90 percent of the flood plain. The most recent major flood occurred September 13, 1961, and flooded over 80 percent of the flood plain. The flood of December 1946, about a 25-year frequency, was the largest in the evaluation series.

Because of the frequency and depth of flooding, farmers cannot utilize the full potential of their fertile flood plain land. They have been forced to change from the production of high value cash crops to a less profitable system of livestock farming. Most of the flood plain cropland is now in tame pasture and hay crops. Despite an urgent need for more leguminous forage, many farmers do not try to grow alfalfa. All of the farmers interviewed in the course of the study said that the flood hazard was the chief deterrent to growing alfalfa on the flood plain. Because of frequent flooding, it is necessary to reseed pasture legumes almost every year.

Other agricultural damages, mainly damage to fences and drowning of livestock, are moderate considering the frequency of floods. There are few boundary line fences across the streambed and the flood plain. Drowning of livestock has been minimized by clearing wooded bottom land areas. Livestock can be gathered readily and shifted to higher ground when flooding is likely to occur. Damage to roads and bridges is relatively small. State and Federal highway bridges were planned to accommodate flood flows and thus suffer little structural damage. Bridges on county roads usually are built high enough that they seldom wash out, but floods inundate the road at both ends of bridges, blocking travel and washing out approaches. Interruption of travel, halting of mail and school bus service, and delay and inconvenience in feeding livestock during flood periods constitute serious problems. Average annual floodwater and indirect damages are estimated at $153,322.

Sediment Damage

Damage by sediment deposition on the flood plain of Lower Clear Boggy Creek ranges from slight to moderately severe. A total of 8,702 acres, about 42 percent of the total flood plain, has been damaged by deposits of silty sand and sandy silt ranging in depth from 6 inches to 2 feet. Damages range from 10 to 60 percent in terms of reduced crop yields. At present there were 1,283 acres damaged 10 percent, 5,271 acres damaged 20 percent, 2,026 acres damaged 40 percent, and 122 acres damaged 60 percent. Damages to roads and bridges by deposition of sediment have been slight and were not evaluated in monetary terms. Sediment damage resulting from overbank deposition is expected to average $28,636 annually.

Under present conditions, it is estimated that 278 acre-feet of sediment are delivered annually to the Boswell Reservoir site representing an additional damage of approximately $5,325 annually.

Erosion Damage

Severe flooding has caused scour damage on 5,701 acres of flood plain land below planned floodwater retarding structures. Damages range from 10 to 60 percent as measured by reduced productivity. There are 1,686 acres damaged 10 percent; 2,974 acres damaged 20 percent; 917 acres damaged 40 percent; and 124 acres damaged 60 percent. The most severe damage on these 5,701 acres has resulted from channel scour on 800 acres. Sheet scour has removed 4 to 12 inches of surface soil from the remaining 4,901 acres.

Sheet erosion on formerly cultivated land is the major source of sediment from the uplands. Gully erosion is moderately severe in some parts of the outcrop area of the Paluxy sand formation.

Erosion caused by burning of tree and grass cover has not been a major problem in the watershed. Educational programs emphasizing the detrimental effects of burning have been effective in preventing fire. These programs have been supported by the schools, towns, and the Extension Service, the Oklahoma State Forestry Division, and the local soil and water conservation districts. Annual erosion damage averages $16,903.

Problems Relating to Water Management

The cities of Caney and Caddo have adequate water supplies which are obtained from wells. The water is of good quality and meets their needs.

Drainage needs can be met by farm drainage systems for which suitable outlets are available. The annual rainfall is usually adequate for the crops grown; droughts do occur and irrigation is used for lawns and gardens.

The Oklahoma Industrial Development and Park Department has made a study of the recreational needs for the area and has recommended recreation as a project purpose to provide facilities for visitors to the Boggy Depot park. A reservoir is needed for the development of these facilities, and the local sponsors have made that request.

Water and other recreational facilities were not adequate for use at this historical-restoration-recreational complex. Twenty-five thousand people live within a reasonable driving distance to utilize the facilities. The site is near U. S. Highway 69. The traffic count in the area indicates 4,600 out-of-State paople and 14,300 local residents are traveling in the immediate vicinity daily.

The water quality is good for recreational development.

PROJECTS OF OTHER AGENCIES

The Boswell Reservoir was designed as a part of the flood control and water conservation network in the Red River Basin by the Corps of Engineers. It was authorized for construction by Congress in 1946. The dam site is located about five miles downstream from the junction of Clear Boggy and Muddy Boggy Rivers. Plans for the Boswell Reservoir have been revised to include water supplies and recreation, and the flood pool elevation was raised from 479 feet to 500 feet mean sea level. The

watershed plan for Lower Clear Boggy Creek has been prepared under the assumption that the Boswell Reservoir is in place at the higher elevation.

BASIS FOR PROJECT FORMULATION

The sponsoring local organization recognizes the need for a comprehensive approach to the watershed problems. Project formulation was based on the land treatment needs for watershed protection and structural measures needed to furnish adequate flood protection to crops and pastures, other agricultural property, roads and bridges, to alleviate scour and sediment damages to agricultural lands caused by lack of channel capacity, and to provide for recreational water storage and the need for outdoor recreational facilities.

This project is included in the comprehensive study made of the Red River Basin Below Denison Dam. In that Basin Report, the Tupelo Reservoir, proposed as a long-range development, is located approximately 7 or 8 miles above the upper portion of the Lower Clear Boggy Watershed.

In the economic analysis of the Lower Clear Boggy project, it has been assumed that upstream PL-566 projects have been installed and are fully effective. The analysis shows that these projects will reduce damages in Lower Clear Boggy Watershed about 31 percent.

The sponsors and the Soil Conservation Service agreed to plan a project that would:

1. Reduce the average annual agricultural damages approximately 85 percent.

2. Provide a recreational development which will meet a portion of the areas need for camping, picnicking, boating, and other water based recreation activities.

It was agreed that these needs could be met through a system of floodwater retarding structures, channel improvement, the inclusion of one multiple-purpose structure to provide storage of water for recreation and flood control, and recreation facilities.

The possibility of adding water storage for irrigation was considered. Because of the crops grown and the lack of an adequate market for higher value crops, the sponsors decided not to include storage for irrigation water.

In selecting the sites for floodwater retarding structures, consideration was given to locations which would give the desired level of flood protection and provide storage of water for recreational use at the least cost.

The size, number, design, and cost of the structures and channel improvement was influenced by obstructions, topographic, and geologic conditions of the watershed.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as is now being carried out by the Atoka County, Bryan County, Coal County, and Johnston County Soil and Water Conservation Districts, and the Bureau of Indian Affairs, is essential for a sound and continuing watershed protection program.

Approximately 69,491 acres of the 199,767 acres of upland in the watershed lie above planned floodwater retarding structures. Land treatment is especially important for protection of these watershed lands to support and protect the structural measures. Proper management is also important on flood plain land above sites.

Land treatment measures on the 17,684 acres of flood plain below floodwater retarding structures are important in reducing floodwater and scour damages on the flood plain and in maintaining high levels of agricultural productivity. There are 887 acres of channels and approximately 17,500 acres to be covered by Boswell Reservoir below the structures. The remainder of the watershed (130,276 acres of upland, 4,326 acres of flood plain, and 137 acres in channels) has no structural control, and the establishment and maintenance of land treatment constitute the only planned measures.

Emphasis will be place on accelerating the establishment of those land treatment measures which will have a measurable effect on reduction of floodwater and sediment damages and the cost of providing sediment storage capacity in floodwater retarding structures.

Table 1 includes estimates of the quantities and cost of land treatment measures important for watershed protection which will be established by the landowners and operators of watershed lands during the 8-year project installation period. They comprise, primarily, measures required to establish good land cover and soil conditions which will decrease erosion damage and sediment yields from cultivated fields and pastures. Cropland treatment measures include: cover cropping, conservation cropping system, and improved tillage to attain crop residue use for soil protection and conditioning. Pasture and rangeland treatment measures include: construction of farm ponds to provide sufficient numbers and locations of watering places to protect vegetative cover, or to make practicable the utilization of land for vegetative cover; pasture planting and range seeding to establish good cover on lands formerly tilled and on range with poor cover; and proper use of pasture and range cover. Practices that will contribute to the expansion and perpetuation of wildlife resources will be installed with protection from fire and livestock. These practices will include wildlife development of ponds, odd upland areas, and wet lands.

In addition to the soil improvement and cover measures above, land treatment includes contour farming, terracing, diversion construction, and the waterway development to serve these measures. Terracing and contour

farming have a measurable effect in reducing peak discharge by slowing the runoff from fields. These measures also augment the soil improvement and cover measures in reducing erosion damage and sediment yield.

Structural Measures

The works of improvement to be installed will include 27 single-purpose floodwater retarding structures, one multiple-purpose structure, and recreational facilities. The multiple-purpose structure will provide recreation storage for the Oklahoma Industrial Development and Park Department.

Approximately 26,000 feet of outlet channel will be constructed below floodwater retarding structures Nos. 5, 6, 22, and 23 through 31 to convey principal spillway release flows from the structures to natural streams. The outlet channels below structures Nos. 5, 6, 22, 23, 27, and 31 are considered appurtenances to the floodwater retarding structures. Channel C-1 was treated as channel improvement.

The system of structures will detain runoff from approximately 57.8 percent of the watershed above the upper limits of the Boswell Reservoir. The structures will have a total floodwater detention capacity of 29,880 acre-feet (table 3) and detain an average of 5.16 inches of runoff from the watershed area above them. Storage for 2,011 acre-feet of water for recreation has been provided in multiple-purpose structure No. 13.

Approximately 374 acres of bottomland and 479 acres of upland in the sediment pool areas, 158 acres of the bottomland, and 202 acres of upland will be in recreation pool acres. An additional 790 acres of bottomland and 2,861 acres of upland will be inundated temporarily by the detention pools.

The recreational facilities will include access roads, trails, parking areas, boat ramps, fishing docks, swimming beach, bath house, water supply, sanitary facilities, picnicking and camping areas, lighting, and covered bridge. A schedule of planned facilities is shown in table 2B. The amount of land needed for the recreational facilities is 720 acres. Cost and design data and a plan for development are shown in tables 2 and 3 and figures 6 and 7. The cost of sharing on the covered bridge will be limited to the cost of a bridge of a quality comparable to that of the road. If the covering of the bridge involves additional cost, the additional cost will be borne by the local sponsors.

The recreational facilities will be installed and operated in accordance with applicable State and local requirements. Recreational use will be contingent upon maintenance of satisfactory water standards in accordance with Oklahoma's Water Quality Criteria (1968), publication number 20 of the Oklahoma Water Resources Board.

Sediment pool design will conform to the Oklahoma Water Resources Board Resolution of January 10, 1961, and all applicable State water laws. Adequate detention storage and release flow are planned to make possible the use of vegetated earth spillways.

As a result of land acquisition for Site 13, it is estimated that nine farm operations will be displaced. Site 9, it is estimated, will cause displacement of one farm operation and dwelling (four persons). No businesses will be affected by the project.

Wildlife Mitigation Measures

Mitigation measures consisting of plantings which will provide food and cover for wildlife will be installed in areas adjacent to some of the floodwater retarding structures. Selected species of plants which are adapted to the area and which have high value to local wildlife species will be established, fenced, protected from grazing, and maintained. The cost of the work is estimated to be $3,000. These mitigation measures will be maintained, as will the floodwater retarding structures, by the soil and water conservation district in which they are located. The Lower Clear Boggy River Conservancy District will cooperate by providing needed financial assistance.

At Site 13, the multipurpose development, there will be wildlife improvement measures including 20 nesting boxes for wood ducks, 50 squirrel nesting boxes, 25 acres of sericea lespedeza, and 10,000 shrubs beneficial to wildlife. These measures will be installed in Sections 4, 5, 9, and 10 in the upper reaches of the development. The estimated cost is $3,200. The Oklahoma Industrial Development and Park Department will provide the local share of installation costs and will perform the operation and maintenance of multipurpose structure No. 13 and of associated recreation facilities and wildlife mitigation measures.

These improvement measures will help to maintain the wildlife resources of the watershed by partially replacing the food and habitat lost due to construction of the planned structural measures.

EXPLANATION OF INSTALLATION COSTS

Public Law 566 funds are expected to provide technical assistance during the eight-year installation period to accelerate the installation of land treatment measures for watershed protection. These funds amount to $114,422, including $3,922 obligated for the Bureau of Indian Affairs. Local interests will install the land treatment measures at an estimated cost of $2,620,934, which includes any assistance under going programs.

Installation costs of all structural measures to be borne by Public Law 566 funds total $3,093,143. The construction costs, $2,550,035, include the engineer's estimates and contingency allowance. Engineering services, $281,017, include direct cost of engineers and other technicians for surveys, investigations, design and preparation of plans, and specifications for structural measures including the vegetative work associated therewith. Project administration, $119,374, includes the cost of contract representatives, construction surveys, and inspection. Public Law 566 land rights cost for multiple-purpose structure No. 13 and related recreation facilities is estimated at $124,886 and relocation at $16,931.

The installation costs of the 27 single-purpose floodwater retarding structures and channel C-1 to be borne by Public Law 566 funds, not including project administration, total $2,201,074. These consist of construction, $1,971,665; engineering services, $225,176; and relocation, $4,233.

The installation costs of the one multiple-purpose structure to be borne by Public Law 566 funds, not including project administration, total $441,680. These consist of construction, $306,030; engineering services, $31,341; land rights, $91,711; and relocation, $12,698.

The installation costs of the recreation facilities to be borne by Public Law 566 funds, not including project administration, total $331,015. These consist of construction, $273,240; engineering services, $24,500; and land rights, $33,275.

Installation costs of all structural measures to be borne by funds other than Public Law 566 funds total $850,089. These consist of construction, $304,210; engineering services, $24,500; land rights, $478,110; project administration $22,200; and relocation, $19,069.

The local sponsors' share of the cost of the 27 single-purpose floodwater retarding structures and channel C-1, not including project administration, is $202,430. This consists of land rights, $162,308; roads, bridges, and utilities, $35,355; and relocation,$4,767.

The local sponsors' share of the cost of the one multiple-purpose structure, not including project administration, is $250,994. This consists of construction, $30,970; land rights, $205,722; and relocation, $14,302.

4 -17920 6-72

The local sponsors' share of the cost of the recreation facilities, not including project administration, is $372,465. This includes construction, $273,240; engineering services, $24,500; and land rights, $74,725.

The local sponsors, without Public Law 566 cost sharing will provide all relocation assistance advisory service ($2,000).

The local sponsors will also bear the costs it incurs in serving notice of displacement, providing appropriate application forms, assisting in filing applications, hearing and resolving grievances, and in making relocation payments. The Service will bear the costs it incurs in assisting the local sponsors in providing those services. These costs are included in the estimates for project administration.

The use-of-facilities method was used to allocate joint construction costs of the multiple-purpose structure. Cost estimates for the construction of the structure were made by the Soil Conservation Service and the Consulting Engineering Firm, based on an analysis of costs for the dam and appurtenant items. An allowance of 15 percent was added for contingencies.

Allocation of purpose was made as follows:

Purpose	Acre-Feet	Percent
Flood Prevention	8,930	81.62
Recreation	2,011	18.38
Total	10,941	100.00

Cost allocation for land rights was made in accordance with Watershed Protection Handbook, Paragraph 108.022. The following table shows the land area needed for each purpose:

Two feet above spillway	1,000 Acres
Dam and spillway	30 Acres
Twice recreation pool	720 Acres
Eligible for 50-50 cost sharing	1,750 Acres
Total area to be purchased	2,840 Acres

Cost sharing:

SCS $\frac{1,750}{2,840} \times 1/2 = 30.81$ Percent

Other $\frac{1,750}{2,840} \times 1/2 + \frac{1,090}{2,840} = 69.19$ Percent

The following table shows the estimated cost and percent to be paid by Public Law 566 funds and other funds.

Multiple-Purpose Structure No. 13	Public Law 566 : Percent	Public Law 566 : Dollars	Other Funds : Percent	Other Funds : Dollars	Total Dollars
Construction	90.81	306,030	9.19	30,970	337,000
Engineering Services	100.00	31,341	-	-	31,341
Subtotal		337,371	-	30,970	368,341
Recreation Facilities					
Construction	50.00	273,240	50.00	273,240	546,480
Engineering Services	50.00	24,500	50.00	24,500	49,000
Subtotal		297,740	-	297,740	595,480
Land Rights	30.81	124,886	69.19	280,447	405,333
Subtotal		124,886	-	280,447	405,333
Relocation		12,698	-	14,302	27,000
TOTAL		772,695	-	623,459	1,396,154

The proposed eight-year schedule of obligation for land treatment and structural measures as shown in the following tables may be adjusted from year to year as mutually agreed, based on appropriations and accomplishments actually made.

LAND TREATMENT MEASURES

Fiscal Year	Public Law 566 Funds (Dollars)	Other Funds (Dollars)	Total (Dollars)
1	12,280	327,616	339,896
2	14,812	327,617	342,429
3	14,812	327,617	342,429
4	14,812	327,617	342,429
5	14,812	327,617	342,429
6	14,812	327,617	342,429
7	14,812	327,617	342,429
8	13,270	327,616	340,886
TOTAL	114,422	2,620,934	2,735,356

STRUCTURAL MEASURES

Fiscal Year	Public Law 566 Funds (Dollars)	Other Funds (Dollars)	Total (Dollars)
1	364,912	84,298	449,210
2	364,912	84,298	449,210
3	538,758	260,000	798,758
4	364,912	84,298	449,210
5	364,912	84,298	449,210
6	364,912	84,299	449,211
7	364,912	84,299	449,211
8	364,913	84,299	449,212
TOTAL	3,093,143	850,089	3,943,232

4-17920 6-72

EFFECTS OF WORKS OF IMPROVEMENT

Under present conditions a 24-hour, 25-year frequency storm will yield 4.75 inches of weighted runoff for the watershed. Such a storm occurred in December 1946. This volume of runoff, under present conditions, will result in a peak flow of 50,400 cubic feet per second at the reference valley section number 22 and cause flooding of 20,443 acres of flood plain land below proposed floodwater retarding structure sites. The accelerated land treatment program will reduce the surface runoff from this storm to 4.67 inches or a peak flow of 49,500 c.f.s. at valley section 22, and the area flooded to 20,375 acres. The installation and full functioning of the floodwater retarding structures will further reduce the peak discharge to 19,350 c.f.s. and the area inundated to 12,709. Figure 2 graphically illustrates the reduction at valley section 22 for the storm of September 1961 which was a storm of approximately 2-year frequency.

With the installation and operation of the project, 35 of the 41 major floods such as those which occurred during the 20-year evaluation period, 1942-1961, would be reduced to minor floods on the flood plain lands below structures. Flooding would be eliminated from 68 of the 137 minor floods which occurred during the 20-year evaluation period. The number of damaging floods which occurred during the evaluation period would be reduced from 178 to 110 for all the flood plain except the area directly above the Boswell Reservoir. Average annual flooding would be reduced from 51,662 acres to 13,418 acres in the benefited areas. Average annual flooding to depths greater than 3 feet would be reduced from 7,214 to 488 acres.

Percent of Flood Plain Inundated	Number of Floods	
	Without Project	With Project
75 or more	16	0
50 to 75	25	6
25 to 50	32	13
10 to 25	47	21
Less than 10	58	70
Total	178	110

AREA INUNDATED

Evaluation Reach	Average Recurrence Interval: 1 Year Without Project (acres)	1 Year With Project (acres)	2 Year Without Project (acres)	2 Year With Project (acres)	5 Year Without Project (acres)	5 Year With Project (acres)	25 Year Without Project (acres)	25 Year With Project (acres)
I	6,110	2,120	7,060	3,110	7,700	4,400	8,111	6,120
II	3,830	1,820	4,040	2,490	4,210	3,255	4,357	3,780
III	910	523	995	690	1,030	880	1,073	1,003
IA	535	140	675	173	970	190	1,412	327
IIA	482	0	710	0	1,120	165	1,389	410
IIIA	938	382	1,080	630	1,276	845	1,342	1,069
TOTAL	12,805	4,985	14,560	7,093	16,306	9,735	17,684	12,709

The effect of the project on flooding for four recurrence intervals of 1, 2, 5, and 25 years are shown above. With the project installed, the Lower Clear Boggy Creek main stem flood plain will experience shallow flooding at the 5-year level. The tributaries will have very little flooding at this same level. Flooding by the 25-year frequency will be reduced from 17,684 acres to 12,709 acres with the largest reduction on the tributaries.

The installation and full functioning of this project will greatly reduce damage from overbank deposition of sediment. Of the 8,702 acres damaged by sediment under present conditions, 1,181 acres will be subject to damage with the project installed. The character of the remaining deposition will be such that full recovery of damage areas will be possible over a short period of time. Damages and sediment produced by flood plain scour will be reduced approximately 87 percent by the installation of the planned works of improvement. Approximately 149 owners of flood plain land will be benefited by the installation of the structural measures.

Reduced frequency and depth of flooding will make it possible for farmers to increase the productivity of flood plain land to former levels and to organize cropping systems to secure maximum returns. Based on a recurrence of the storms in the evaluation series, the flood threat will be eliminated from 4,975 acres. This will permit more intensive use of this fertile land. The most important shift will be an increase in alfalfa of about 2,124 acres. It can be expected that most farmers will begin to grow alfalfa. It will be profitable to clear much of the relatively unproductive wooded pasture for higher use.

Land treatment will reduce the volume of sediment delivered to the Boswell Reservoir from 278 to 238 acre feet annually. Both land treatment and structural measures will reduce the amount of sediment delivered annually to 148 acre feet. The installation of the project therefore will reduce the amount of sediment delivered to the reservoir by 130 acre feet annually.

During the construction and following the installation of a complete flood prevention project, the general level of business activity in the watershed will be expected to increase. Agricultural production will also increase

following the completion of the project because the risk from flooding is greatly lessened. Increased farm production stimulates the demand for labor and the supplies used in farming. Processors of agricultural commodities and other businesses in the trade territory benefit from the project. There will be general improvement in the economic well being of the inhabitants of the region. Secondary benefits of $22,700 may be expected to result from this project.

The recreation development associated with multipurpose site 13R will provide opportunity for an estimated 123,612 visitor days of water related activities per year. A development of this magnitude, to be included in a proposed State Park by the sponsors, will have a considerable effect on the economy of the area. The principal kinds of activities expected will be during the summer season and include picnicking, camping, boating, swimming and fishing. Peak daily use is estimated at 3350 visitors.

PROJECT BENEFITS

The combined program of land treatment and structural measures, including other upstream projects, will reduce average annual damages from $198,861 to $40,872. This is a damage reduction benefit of $157,989, or 79.4 percent. Approximately 91.6 percent of this reduction will result from structural measures.

Changes that can be expected in the flood plain use were analyzed. It was assumed that restoration of former productivity and changed land use would be confined to portions of the flood plain that would be inundated on an average of no more than once in three years after installation of the project. Benefits from restoration of former productivity have been included in the benefits from reduction of damage to crops and pasture (table 5). Benefits from changed land use are estimated to average $28,174 annually. None of the benefits from restoration of former productivity or changed land use were derived from increased acreage of allotted crops.

Damage from sediment deposition in Boswell Reservoir will be reduced $5,325 each year as a result of the structural measures installed in this project.

Within the project area, structural measures will reduce average annual damages $84,812.

The project will benefit fish and wildlife. The land treatment practices will improve the habitat for quail, deer, rabbits, squirrels, and other upland game. There will be better and more flood-free nesting areas for quail in and near the flood plain. The sediment pools of the structure will benefit fish, waterfowl, and furbearing animals such as muskrats, mink, and raccoon.

Total primary benefits from structural measures will average $331,729 annually.

Secondary benefits from a national viewpoint were not considered pertinent to this evaluation. However, the increased farm production will provide a nearby outlet for labor in the watershed communities and will provide additional business for suppliers of products used in farming. Installation of the project thus will tend to stabilize the agriculture and

promote the economic well-being of the area. Local secondary benefits of this nature were estimated to average $22,700 annually and were used for project justification. The total average annual benefits from the structural measures in this project will be $354,429.

The total average annual flood reduction benefits from land treatment measures amount to $12,663. These benefits have not been used for project justification.

The watershed is located in an area designated by the Secretary of Agriculture as eligible for development under the Economic Development Act of 1965. Redevelopment benefits were used for project justification.

The area has scenic and recreational resources that can be utilized more fully after the structural measures are installed. The reservoir created by the floodwater retarding structures of this project will provide increased opportunity for fishing, boating, picnicking, hunting, and trapping. Peak daily use is estimated at 3350 visitors. The average annual visitor days are estimated to be 123,612, which at a unit value of $1.50 will produce an annual benefit of $185,418. The increased numbers of wild fowl and fur-bearing animals will benefit the economy of the area. These benefits were evaluated in monetary terms and used in the justification of this project.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures (amortized from total installation cost plus operation and maintenance) is $213,760. The installation of the structural measures is expected to produce average annual primary benefits of $331,729. The ratio of primary benefits to cost will be 1.6:1.0.

Total benefits, including secondary benefits, from the structural measures will provide a benefit of $1.70 for each dollar of equivalent cost (table 6).

PROJECT INSTALLATION

The land treatment measures will be established by the landowners or operators over an 8-year period in cooperation with the Atoka County, Bryan County, Coal County, and Johnston County Soil and Water Conservation Districts. Progress in establishing land treatment measures will be kept ahead of installation of structural measures by concentrating activities in the drainage area above the proposed floodwater retarding structures. The Soil Conservation Service, through the soil and water conservation districts, is giving technical assistance in the planning and application of these measures under going programs. Technical assistance will be accelerated by assignment of additional personnel, as needed, to assure satisfactory planning progress and the application of the planned measures within the project installation period.

The Bureau of Indian Affairs will assist with land rights on structures which affect Indian land under their jurisdiction. They will, through their operating units, give technical assistance in the planning and application of land treatment measures under their going program.

The Oklahoma Industrial Development and Park Department, in connection with displacements caused by Site 13; the Lower Clear Boggy River Conservancy District; and the Coal County, Atoka County, Bryan County, and Johnston County Conservation Districts, in connection with displacements caused by Site 9, will provide personally or by first class mail written notice of displacement and appropriate application forms to each displaced person or farm operation. The local sponsors will also assist in filing applications, review and take action on applications for relocation assistance, review and process grievances in connection with displacements, and make relocation payments.

As a part of project administration, the Service will assist the local sponsors in fulfilling its responsibilities. The local sponsors will provide all relocation assistance advisory service. The local sponsors have determined that comparable, decent, safe, and sanitary replacement housing will be available for persons subject to displacement by this project; such displaced persons will be given notice to vacate at least 90 days before they have to move.

The governing bodies of the soil and water conservation districts will assume leadership in accelerating the planned land treatment measures.

The landowners and operators within the watershed will be encouraged to apply and maintain soil and water conservation measures on their farms and ranches. District-owned equipment will be made available to the landowners and operators in accordance with existing arrangements for usage of equipment in the districts.

The soil and water conservation districts will encourage landowners and operators to leave the timber on the steep slopes and draws adjacent to the flood plain. They will also encourage farmers to leave a strip of trees, where possible, along the main channel.

At the request of the sponsors, the Soil Conservation Service will contract for the construction of 27 floodwater retarding structures. The sponsor responsible for dealing with the Service during construction is the Lower Clear Boggy Conservancy District. The local sponsors will provide, at no cost to the Federal Government, all the land rights, roads, utilities, pipelines, and other improvements, and their removal or relocation as needed, for the construction of the floodwater retarding structures.

The Soil Conservation Service will contract for the construction of multiple-purpose structure 13 and related recreation facilities. The Oklahoma Industrial Development and Park Department will develop construction plans and specifications, including geological investigations and laboratory analyses, and will provide general supervision during construction to protect their interest.

The Soil Conservation Service will check and approve construction plans and specifications and furnish construction inspection of the multiple-purpose structure.

On the multiple-purpose structure, the Service will perform such construction inspection with Public Law 566 funds as is deemed necessary to protect the Government's interest; the Oklahoma Industrial Development and Park Department will perform such inspection without Public Law 566 cost sharing as it deems necessary to protect its interest. No detailed accounting of expenses involved nor transfer of funds will be involved in construction inspection.

The legal fees incurred in acquiring land easements and rights-of-way for all structural measures and cost of contract administration will be furnished by the local sponsors.

Federal funds may be provided and construction of planned structures will be started when the following conditions of one of the following options are met:

OPTION A

1. Have secured 100% of the needed land rights in one or more construction units having two years of design and construction work.

2. Have a plan for satisfying the needs for operation and maintenance of completed works of improvement.

3. Have assured the State Conservationist that they plan to complete the project.

OPTION B

1. Have the power of eminent domain.

2. Have ability or resources to insure completion of the project to include one of the following:

   a. Have a conservancy district which has made appraisals of benefits in the district and have had such appraisals approved by the Court of Jurisdiction.

   OR

   b. Have sufficient funds on hand which when associated with demonstrated ability to secure land rights will insure the progressive completion of all structural measures in any construction unit on which construction is to be started.

3. Have advised the State Conservationist that they are willing to use the power of eminent domain and the financial resources to complete the project.

4. Have obtained sufficient land rights or have options for land rights for all structural measures in one or more construction units which represents two years design or construction work.

OPTION C

1. Have power of eminent domain.

2. Have enough funds on hand which when associated with a plan to raise additional needed funds to complete the project, can be considered by the Service to be adequate to support a design and construction start based upon demonstrated ability to secure needed land rights.

3. Have assured the State Conservationist that they will use the power of eminent domain and their financial resources to obtain all remaining land rights for all structural measures in any construction unit on which construction is to be authorized.

4. Have obtained all needed land rights or options for land rights on 50 percent of the sites in the project which represents two years design and construction work.

5. The sites cleared must be so located that they can be grouped into logical Contract Units.

OPTION D

1. Have power of eminent domain.

2. Have enough funds on hand which when associated with a plan to raise additional needed funds for completion of the project, can be considered by the Service to be adequate to support a design and construction start based upon demonstrated ability to secure needed land rights.

3. Have assured the State Conservationist that they will use the power of eminent domain and their financial resources to obtain all remaining land rights in a construction unit on which construction is to be started.

4. Have obtained land rights or have options to obtain land rights for 50 percent of the sites in a construction unit having at least four years of design and construction work.

5. Have obtained needed land rights or options to obtain land rights for all structural measures for two years of design and construction work which will form logical Contract Units.

Technical assistance will be provided by the Soil Conservation Service to assist in the preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of the 27 floodwater retarding structures.

The soil and water conservation districts will encourage the landowners of structure sites to add facilities and manage the sediment pools for the greatest amount of recreational use through fish and wildlife development.

Management, public appeal, and access may be encouraged through:

1. Technical assistance in fish and wildlife development and management of the sediment pools, municipal pools, and adjacent land.

2. Recreation facilities for picnicking, camping, hunting and fishing, and sanitary facilities.

3. Individual arrangements for use or lease as the landowner prefers.

4. Voluntary organization of landowners:

   a. Central location to sell permits to use facilities.
   b. Advertisement through maps, signs, brochures, and news media.
   c. Standard fees.
   d. Safety programs.

5. Farmers Home Administration assistance to operators in the installation of income producing, water related recreational facilities.

To enhance fish and wildlife development in the watershed, the local sponsors will encourage landowners, where feasible and practical, to apply the following practices:

1. Strictly control or eliminate grazing on fenced dam and spillway.

2. Plant high-quality habitat plants within fenced area, on back toe of dam, and on selected portion of drainage channels.

3. Provide water level control structures on principal spillway drawdown tube.

4. Treat timber edges (cutback borders). This practice is defined as a strip at the edge of woodlands 25 to 50 feet wide converted from trees to herbaceous vegetation or shrubs. This may be accomplished by cutting or herbicidal treatment.

5. Encourage and protect natural habitat along county roads, odd areas, fence lines, field borders, drainages, etc.

6. Practice proper use of rangelands and pastures.

7. Overseed selected areas with Korean or Kobe lespedeza.

8. Plant border strips of serecia lespedeza along field edges.

9. Make habitat plantings on selected sites, utilizing recommended species of trees, shrubs, grasses, and legumes.

10. Release selected seed-producing trees for increased mast production.

11. Install squirrel nesting boxes where needed.

12. Stock sediment pools with only recommended species of fish and encourage proper management.

13. Make provisions for complete drainage of sediment pools.

14. Apply rotenone to eradicate undesirable fish populations on the watershed. Restock with adaptable species.

15. Make provisions for access by fishermen to stocked sediment pools.

16. Treat critical areas with plantings of high value to wildlife.

17. Install spawning devices for channel catfish in sediment pools stocked with this species.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement as described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

All necessary land rights and removal or relocation of roads, pipelines, utilities, and improvements will be obtained within each construction unit before Federal financial assistance is made available for installation of structural measures.

Construction of the planned structural measures will be started as soon as the project is approved, the contracting agencies have funds available and are prepared to discharge their responsibilities, Public Law 566 funds have been appropriated, the necessary easements have been obtained, and operation and maintenance agreements have been executed.

The sponsoring organizations fully recognize their obligations and expected expenses. The Atoka County, Bryan County, Coal County, and Johnston County Soil and Water Conservation Districts are legal subdivisions of the State of Oklahoma. Each has powers of eminent domain and the authority to use State revolving funds in watershed operations. Each soil and water conservation district will provide for financing the local sponsoring organization's responsibilities in construction within its own district by contributions of easement, services and monies, and thru the use of State, county, and watershed revolving funds.

The non-Federal part of the cost of installing the project will be met largely by donations of land rights, material, labor, equipment, services, and money. All landowners were contacted by the local sponsors during the development of the work plan, and it is expected that the major portion of the land rights will be donated. Donations will be supplemented by private credit where feasible.

If funds obtained by contributions, donations, and use of state, county, and local revolving funds prove inadequate, a determination will then be made as to the additional funds needed. An application may then be made to borrow these funds from the Farmers Home Administration.

Relocation assistance advisory services and relocation payments will be financed by the local sponsors through funds made available by a Farmers Home Administration loan and by state legislature appropriations.

The Lower Clear Boggy Conservancy District is a legal subdivision of the state with powers of taxation and eminent domain. The sponsors will use the powers of assessment vested in the conservancy district to raise the additional funds. If a loan is obtained from the Farmers Home Administration, the conservancy district will use its powers to assure repayment of the loan.

The county Agricultural Stabilization Conservation Committee will cooperate with the sponsoring organizations by selecting and providing financial assistance for those land treatment measures which will meet the conservation objectives in the shortest possible time.

The soil and water conservation loan program of Farmers Home Administration is available to all eligible farmers and ranchers in the area. Present clients will be encouraged to cooperate in the project. Educational meetings will be held in cooperation with other agencies to outline the services available and eligibility requirements.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by the landowners or operators of the farms on which the measures are installed under agreement with the soil and water conservation districts. Representatives of the Atoka County, Bryan County, Coal County, and Johnston County Soil and Water Conservation Districts will make, or cause to be made, periodic inspection of the completed land treatment measures to determine maintenance needs and to encourage landowners and operators to perform needed maintenance. They will make district-owned equipment available for this purpose.

Structural Measures

The kinds of maintenance most likely to be needed are as follows:

1. Emergency spillway
2. Rills on slope of embankment
3. Damage on upstream slope from wave action
4. Principal spillway outlet
5. Removal of debris from the principal spillway

The Oklahoma Industrial Development and Park Department will be responsible for the operation and maintenance of the multiple-purpose structure. The estimated average annual operation and maintenance costs are as follows:

27 Single-Purpose Floodwater Retarding Structures and Appurtenances	$ 3,152
1 Multiple-Purpose Structure and Recreation Facilities	$50,000
Total	$53,152

Operation and maintenance for the 27 floodwater retarding structures will be accomplished through the use of contributed labor and equipment, by contract, district-owned equipment, force account, or a combination of these methods. Funds for operation and maintenance work will be obtained by donation or from revenue derived from levies on the benefited lands in the watershed. Funds for operation and maintenance of the multiple-purpose structure will be obtained from water revenue.

Operation and maintenance inspections for all structures will be made on the following basis:

a. The Service employee responsible for operation and maintenance inspections and follow-up and the sponsors will make a joint inspection annually, after unusually severe floods, and after the occurrence of any other unusual conditions that might adversely affect the structural measure. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made annually by the sponsors. They will prepare a report and send a copy to the Service employee responsible for operation and maintenance inspections and follow-up. In situations where the sponsors have shown lack of ability to properly carry out inspections or where conditions indicate need for continued Service assistance, the Service may continue to provide assistance after the third year. This should be only for special situations as determined by the State Conservationist.

b. The Service employee responsible for operation and maintenance inspections and follow-up will thoroughly review the sponsors' operation and maintenance reports of inspections and maintenance. Evidence that inspections or needed maintenance are not being performed properly and promptly will be reported immediately to the State Conservationist, who must then take appropriate action on the reported deficiencies.

An "establishment period" of three years after the acceptance of a structural work of improvement is hereby prescribed. During this period, with prior approval of the Administrator, the Service may bear such part of the cost of any needed repairs as is proportionate to the original costs borne by the Service in the construction of the work of improvement. Specifically excluded from this policy are:

a. Channels or portions thereof which do not incorporate permanent linings such as concrete riprap, or grouted rock.

b. Routine upkeep including replacement of minor or short-lived parts of structures, equipment, or facilities.

c. Repairs determined by the Service to have been caused by improper operation or routine upkeep or both.

d. Repairs for any purpose for which construction costs are not authorized to be paid for in whole or in part with funds appropriated to the Service.

District and Federal representatives will have free access to inspect the improvements at any time.

The sponsoring local organizations fully understand their obligations for maintenance and will execute maintenance agreements prior to an invitation to bid.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/
Lower Clear Boggy Creek Watershed, Oklahoma

CONSTRUCTION COST UPDATED WITH SUPPLEMENT

Item	Unit	Number to be Applied	Estimated Cost (Dollars) 3/ Public Law 566 Funds	Other 2/	Total
LAND TREATMENT					
Soil Conservation Service					
Brush Control	Acre	7,500	-	37,500	37,500
Conservation Crop System	Acre	8,000	-	88,000	88,000
Crop Residue Use	Acre	8,000	-	5,200	5,200
Contour Farming	Acre	1,200	-	1,080	1,080
Critical Area Planting	Acre	1,000	-	30,000	30,000
Debris Basins	No.	20	-	8,000	8,000
Deferred Grazing	Acre	5,615	-	5,615	5,615
Diversions	Foot	26,400	-	1,500	1,500
Field Ditches	Foot	192,000	-	13,400	13,400
Mains and Laterals	Foot	39,000	-	5,400	5,400
Grassed Waterway	Acre	20	-	1,840	1,840
Land Smoothing	Acre	8,000	-	40,000	40,000
Pasture Planting	Acre	50,700	-	1,522,671	1,522,671
Pasture/Hayland Management	Acre	65,000	-	585,000	585,000
Ponds	No.	225	-	67,500	67,500
Terraces	Foot	52,800	-	2,120	2,120
Wildlife Habitat Development	Acre	1,000	-	10,000	10,000
Proper Grazing C	Acre	20,000	-	70,000	70,000
Technical Assistance			110,500	35,000	145,500
SCS Subtotal			110,500	2,529,826	2,640,326
Bureau of Indian Affairs					
Land Use Planning	Acre	3,138	-	628	628
Contouring	Acre	237	-	711	711
Cover Crop	Acre	487	-	3,896	3,896
Cropping System	Acre	3,981	-	5,972	5,972
Crop Residues	Acre	268	-	268	268
Deep Plowing	Acre	93	-	465	465
Conservation Fencing	Mile	222	-	6,660	6,660
Fertilizers (Cons. Crops)	Acre	1,141	-	7,987	7,987
Rough Tillage	Acre	244	-	732	732
Seeding and Sodding	Acre	2,177	-	43,540	43,540
Weed Control	Acre	2,312	-	4,624	4,624
Ponds	No.	29	-	8,700	8,700
Terraces	Mile	13	-	2,925	2,925
Technical Assistance			3,922	4,000	7,922
BIA Subtotal			3,922	91,108	95,030
TOTAL LAND TREATMENT			114,422	2,620,934	2,735,356
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Strs.	No.	27	1,915,059 4/	-	1,915,059
Multiple-Purpose Structures	No.	1	306,030	30,970	337,000
Channel C-1	Mile	2.02	56,606	-	56,606
Recreation Facilities			273,240	273,240	546,480
SCS Subtotal			2,550,935	304,210	2,855,145
Subtotal - Construction			2,550,935	304,210	2,855,145
Engineering Services					
Soil Conservation Service			276,017	24,500	300,517
Bureau of Indian Affairs			5,000	-	5,000
Subtotal - Engineering Services			281,017	24,500	305,517
Project Administration					
Soil Conservation Service					
Construction Inspection			93,427	-	93,427
Other			36,513	24,200	60,713
Subtotal - Administration			129,940	24,200	154,140
Other Costs					
Land, Easements, and Rights-of-Way			131,251	497,179	628,430
Subtotal - Other Costs			131,251	497,179	628,430
TOTAL STRUCTURAL MEASURES			3,093,143	850,089	3,943,232
TOTAL PROJECT			3,207,565	3,471,023	6,678,588
SUMMARY					
Subtotal SCS			3,198,643	3,379,915	6,578,558
Subtotal BIA			8,922	91,108	100,030
TOTAL PROJECT			3,207,565	3,471,023	6,678,588

1/ No Federal land involved.
2/ Includes reimbursement from ACP and other Federal funds under going programs.
3/ Price Base: 1968.
4/ Includes $3,000 for plantings for mitigation of wildlife damages.

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Lower Clear Boggy Creek Watershed, Oklahoma
(Dollars) 1/

Item 4/	Installation Cost P.L. 566 Funds				Installation Cost - Other Funds				Total Installation Cost
	Construction 3/ 4/	Engineering	Land Rights 2/	Total P.L. 566	Construction	Engineering	Land Rights 2/	Total Other	
Floodwater Retarding Structures:									
No. 4	54,490	6,469		60,959		2,465		2,465	63,424
5 2/	61,797	7,342		69,139		5,990		5,990	75,129
6 2/	48,245	5,732		53,977		6,930		6,930	60,907
7	44,749	5,317		50,066		3,910		3,910	53,976
8	60,638	7,198		67,836		2,430		2,430	70,266
9	109,214	12,964		122,178		11,930		11,930	134,108
10	139,465	13,943		153,408		15,740		15,740	169,148
11A	64,686	7,678		72,364		6,205		6,205	78,569
12	34,408	4,084		38,492		2,765		2,765	41,257
14	55,461	6,587		62,048		2,840		2,840	64,888
16	84,474	10,033		94,507		5,500		5,500	100,007
17	108,634	12,903		121,537		2,240		2,240	123,777
18	31,736	3,767		35,503		2,180		2,180	37,683
19	32,545	3,863		36,408		2,330		2,330	38,738
20	61,883	7,352		69,235		4,305		4,305	73,540
21	95,533	11,340		106,873		6,005		6,005	112,878
22 2/	74,265	8,823		83,088		12,355		12,355	95,443
23 2/	42,205	5,014		47,219		4,885		4,885	52,104
24	79,502	9,437		88,939		15,730		15,730	104,669
25	130,832	13,090		143,922		9,065		9,065	152,987
26	90,027	10,686		100,713		7,155		7,155	107,868
27 2/	46,459	4,332		50,791		5,305		5,305	56,096

(Footnotes on last page)

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION (Continued)

Lower Clear Boggy Creek Watershed, Oklahoma
(Dollars) 1/

Item 3/	Installation Cost P.L. 566 Funds: Construction	Engineering	Land Rights	Total P.L. 566	Installation Cost - Other Funds: Construction	Engineering	Land Rights	Total Other	Total Installation Cost
Floodwater Retarding Structures:									
No. 28	33,848	4,021		37,869			785	785	38,654
29	53,862	6,400		60,262			7,230	7,230	67,492
30	38,808	4,611		43,419			3,430	3,430	46,849
31 2/	144,837	14,491		159,328			20,245	20,245	179,573
32	92,456	10,975		103,431			15,030	15,030	118,511
Subtotal	1,915,059	218,452		2,133,511			185,030	185,030	2,318,541
Channel C-1	56,606	6,724		63,330			17,400	17,400	80,730
Subtotal	1,971,665	225,176		2,196,841			202,430	202,430	2,399,271
Multi-Purpose Structure 13 R	306,030	31,341	97,976	435,347	30,970		220,024	250,994	686,341
Basic Recreational Facilities	273,240	24,500	33,275	331,015	273,240	24,500	74,725	372,465	703,480
Subtotal	579,270	55,841	131,251	766,362	304,210	24,500	294,749	623,459	1,389,821
Project Administration				129,940				24,200	154,140
GRAND TOTAL	2,550,935	281,017	131,251	3,093,143	304,210	24,500	497,179	850,089	3,943,232

1/ Price Base: 1968.
2/ Cost includes outlet channels.
3/ Sites 1, 2, 3, 15, 33, 34, 35, 36, and 37 deleted from plan.
4/ Includes $3,000 for wildlife plantings.

November 1969

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Lower Clear Boggy Creek Watershed, Oklahoma
(Dollars) 1/

Item	COST ALLOCATION			COST SHARING					
	PURPOSE			P.L. 566			OTHER		
	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total
Floodwater Retarding Structures:									
4 through 14; and 16 through 32; and Channel C-1	2,399,271	-	2,399,271	2,196,841	-	2,196,841	202,430	-	202,430
Multiple-Purpose Structure No. 13	340,506	345,835	686,341	317,397	117,950	435,347	23,109	227,885	250,994
Basic Recreational Facilities	-	703,480	703,480	-	331,015	331,015	-	372,465	372,465
GRAND TOTAL	2,739,777	1,049,315	3,789,092	2,514,238	448,965	2,963,203	225,539	600,350	825,889

1/ Price Base 1968

November 1969

TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS

Lower Clear Boggy Creek Watershed, Oklahoma
(Dollars) 1/

Item	Unit	Quantity	Estimated Unit Cost	Total Construction Cost
Road (2-lane, hard-surfaced)	Mile	4.5	40,000	180,000
Road (1-lane, unimproved)	Mile	1.0	12,000	12,000
Bridle Trail	Mile	6.3	1,400	9,100
Hiking Trail	Mile	4.0	1,200	4,800
Parking (Gravel)	S.Y.	20,000	2	40,000
Cooking Grills	Ea.	60	60	3,600
Garbage Can Holders	Ea.	60	60	3,600
Water Wells	Ea.	3	2,000	6,000
Boat Ramp (2-lane concrete)	Ea.	2	1,500	3,000
Boat Dock	Ea.	2	2,500	5,000
Fishing Dock	Ea.	2	5,000	10,000
Bath House (with 8 flush toilets, dressing room, & showers)	Ea.	1	12,000	12,000
Ski Jump	Ea.	1	2,000	2,000
Duck Blind	Ea.	5	200	1,000
Site Clearing & Landscaping	Acre	80	400	32,000
Swimming Beach	S.F.	50,000	0.25	12,500
Picnic Tables	Ea.	100	120	12,000
Shelters	Ea.	4	5,000	20,000
Toilets, Pit (1 + 1)	Ea.	11	1,200	13,200
Sewage System	Job	L.S.	8,000	8,000
Water System	Job	L.S.	20,000	20,000
Area Lighting	Job	L.S.	6,000	6,000
Fence	Mile	13	1,000	13,000
Diving Board	Ea.	1	1,200	1,200
Cattle Guard	Ea.	4	1,200	4,800
Life Guard Stand	Ea.	2	150	300
Camp Site	Ea.	50	600	30,000
Sign, Entrance	Ea.	3	400	1,200
Bulletin Board	Ea.	2	250	500
Covered Bridge 2/	Ea.	1	30,000	30,000
Subtotal				496,800
Contingencies (10 percent)				49,680
GRAND TOTAL				546,480

1/ Base Price 1966

2/ 50-50 cost sharing will be provided for a bridge considered equal in quality to the road involved; any additional cost for the covering will be a local cost item.

November 1969

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Lower Clear Boggy Creek Watershed, Oklahoma

Item	Unit	STRUCTURE NUMBER 4	5	6	7	8	9	10
Drainage Area 1/	Sq.Mi.	2.30	1.58	0.60	2.37	1.63	6.78	7.43
Storage Capacity 1/								
Sediment Pool	Ac.Ft.	74	71	23	71	50	257	281
Recreation Pool	Ac.Ft.	-	-	-	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	12	13	4	11	9	51	56
Floodwater Detention Pool	Ac.Ft.	629	447	169	637	462	1,171	1,989
Total	Ac.Ft.	715	531	196	719	521	1,479	2,326
Surface Area 1/								
Sediment Pool	Acre	15	13	6	20	11	55	65
Recreation Pool	Acre	-	-	-	-	-	-	-
Detention Pool	Acre	74	55	26	88	52	190	255
Volume of Fill	Cu.Yd.	56,700	55,700	40,500	45,400	68,900	121,300	155,300
Elevation Top of Dam 1/	Foot	637.0	556.5	556.5	573.0	578.5	633.0	643.0
Maximum Height of Dam 1/	Foot	39	29	26	29	33	33	31
Emergency Spillway								
Crest Elevation 1/	Foot	631.5	552.5	553.0	569.0	574.5	629.0	639.0
Bottom Width 1/	Foot	70	78	40	82	66	480	286
Type		Rock	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 3/		4	4	4	4	4	10	4
Average Curve No. - Condition II		82	76	76	74	74	79	79
Emergency Spillway Hydrograph								
Storm Rainfall (6-hour)	Inch	6.46	6.56	6.73	6.46	6.55	6.15	6.10
Storm Runoff	Inch	4.41	3.86	4.02	3.53	3.66	3.82	3.77
Velocity of Flow (Vc) 4/	Ft./Sec.	3.2	0	0	0	0	4.0	0
Discharge Rate 4/	C.F.S.	36	0	0	0	0	891	0
Maximum Water Surface Elevation 1/ 4/	Foot	632.0	-	-	-	-	630.1	-
Freeboard Hydrograph								
Storm Rainfall (6-hour)	Inch	14.99	15.22	15.62	14.86	15.07	14.13	14.04
Storm Runoff	Inch	12.64	11.99	12.38	11.36	11.56	11.37	11.29
Velocity of Flow (Vc) 4/	Ft./Sec.	10.3	8.8	8.0	8.7	8.7	8.7	8.7
Discharge Rate 4/	C.F.S.	2,293	1,527	615	1,566	1,276	9,190	5,496
Maximum Water Surface Elevation 1/ 4/	Foot	637.0	556.5	556.4	573.0	578.5	633.0	643.0
Principal Spillway								
Capacity - Maximum	C.F.S.	13	13	5	19	13	54	5/ 81
Sediment Pool Elevation 1/	Foot	615.7	539.6	542.1	556.0	559.0	618.0	625.3
Capacity Equivalents 1/								
Sediment Volume	Inch	0.60	0.84	0.71	0.56	0.58	0.71	0.71
Recreation Pool	Inch	-	-	-	-	-	-	-
Sediment in Detention Pool	Inch	0.10	0.16	0.14	0.09	0.10	0.14	0.14
Detention Volume	Inch	5.13	5.30	5.28	5.04	5.32	3.24	5.02
Spillway Storage	Inch	4.27	3.00	3.50	3.32	2.73	2.55	3.04
Class of Structure		A	A	A	A	A	A	A

(See footnotes on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Lower Clear Boggy Creek Watershed, Oklahoma

Item	Unit	STRUCTURE NUMBER						
		11A	12	13	14	16	17	18
Drainage Area 1/	Sq.Mi.	1.02	0.83	25.14 2/	3.55	4.35	2.49	1.11
Storage Capacity 1/								
Sediment Pool	Ac.Ft.	32	25	952	136	167	96	37
Recreation Pool	Ac.Ft.	-	-	2,011	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	6	4	188	28	35	20	7
Floodwater Detention Pool	Ac.Ft.	280	226	7,790	971	1,181	692	314
Total	Ac.Ft.	318	255	10,941	1,135	1,383	808	358
Surface Area 1/								
Sediment Pool	Acre	11	8	146	18	30	16	12
Recreation Pool	Acre	-	-	360	-	-	-	-
Detention Pool	Acre	40	34	899	82	158	73	50
Volume of Fill	Cu.Yd.	58,300	38,200	189,000	51,900	77,900	111,000	32,700
Elevation Top of Dam 1/	Foot	596.5	569.0	586.0	631.0	739.5	731.5	577.0
Maximum Height of Dam 1/	Foot	27	28	48	51	38	41	25
Emergency Spillway								
Crest Elevation 1/	Foot	594.5	565.5	582.0	625.0	735.5	727.5	573.5
Bottom Width 1/	Foot	51	50	280	64	220	144	56
Type		Veg.	Veg.	Veg.	Rock	Veg.	Veg.	Veg.
Percent Chance of Use 3/		4	4	2.8	4	4	4	4
Average Curve No. - Condition II		75	75	79	77	80	80	75
Emergency Spillway Hydrograph								
Storm Rainfall (6-hour)	Inch	6.75	6.69	7.0	6.36	6.30	6.44	6.64
Storm Runoff	Inch	3.93	3.86	4.58	3.79	4.05	4.18	3.83
Velocity of Flow (Vc) 4/	Ft./Sec.	0	0	0	0	0	0	0
Discharge Rate 4/	C.F.S.	0	0	0	0	0	0	0
Maximum Water Surface Elevation 1/ 4/	Foot	-	-	-	-	-	-	-
Freeboard Hydrograph								
Storm Rainfall (6-hour)	Inch	9.6	15.38	11.5	14.62	14.49	14.81	15.26
Storm Runoff	Inch	6.50	12.00	8.83	11.56	11.87	12.19	11.88
Velocity of Flow (Vc) 4/	Ft./Sec.	6.0	8.1	9.0	11.0	8.9	8.9	8.2
Discharge Rate 4/	C.F.S.	330	801	6,263	2,492	4,530	2,980	906
Maximum Water Surface Elevation 1/ 4/	Foot	596.5	569.0	585.9	631.0	739.5	731.5	577.0
Principal Spillway								
Capacity - Maximum	C.F.S.	13	7	501 5/	39 5/	48 5/	27 5/	9
Sediment Pool Elevation 1/	Foot	582.1	553.8	569.1	603.7	720.8	709.7	562.8
Capacity Equivalents 1/								
Sediment Volume	Inch	0.59	0.57	0.71	0.72	0.72	0.72	0.62
Recreation Pool	Inch	-	-	1.50	-	-	-	-
Sediment in Detention Pool	Inch	0.11	0.10	0.14	0.15	0.15	0.15	0.12
Detention Volume	Inch	5.15	5.11	5.81	5.13	5.09	5.21	5.30
Spillway Storage	Inch	1.63	3.21	3.00	2.96	3.24	2.49	3.34
Class of Structure		A	A	A	A	A	A	A

(See footnotes on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Lower Clear Boggy Creek Watershed, Oklahoma

Item	Unit	STRUCTURE NUMBER 19	20	21	22	23	24	25
Drainage Area 1/	Sq.Mi.	1.12	2.68	3.11	4.45	0.67	4.75	5.33
Storage Capacity 1/								
Sediment Pool	Ac.Ft.	38	73	86	135	21	152	179
Recreation Pool	Ac.Ft.	-	-	-	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	7	13	17	21	4	30	34
Floodwater Detention Pool	Ac.Ft.	313	903	849	1,177	191	1,284	1,436
Total	Ac.Ft.	358	989	952	1,333	216	1,466	1,649
Surface Area 1/								
Sediment Pool	Acre	11	20	29	35	6	58	31
Recreation Pool	Acre	-	-	-	-	-	-	-
Detention Pool	Acre	50	89	91	151	30	220	156
Volume of Fill	Cu.Yd.	34,200	65,900	103,900	69,400	42,800	31,900	150,200
Elevation Top of Dam 1/	Foot	576.0	598.5	596.0	618.0	586.5	561.5	621.0
Maximum Height of Dam 1/	Foot	27	35	28	34	26	25	42
Emergency Spillway								
Crest Elevation 1/	Foot	572.5	594.5	592.0	614.0	583.0	557.5	617.0
Bottom Width 1/	Foot	54	252	140	138	40	330	272
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 3/		4	2	4	4	4	4	4
Average Curve No. - Condition II		75	75	76	76	76	77	79
Emergency Spillway Hydrograph								
Storm Rainfall (6-hour)	Inch	6.63	9.64	6.38	6.29	6.70	5.94	6.23
Storm Runoff	Inch	3.83	6.67	3.71	3.63	3.99	3.43	3.89
Velocity of Flow (Vc) 4/	Ft./Sec.	0	3.4	0	0	0	0	2.8
Discharge Rate 4/	C.F.S.	0	316	0	0	0	0	62
Maximum Water Surface Elevation 1/ 4/	Foot	-	595.4	-	-	-	-	617.2
Freeboard Hydrograph								
Storm Rainfall (6-hour)	Inch	15.25	21.21	14.68	14.46	15.41	13.65	14.33
Storm Runoff	Inch	11.87	17.67	11.47	11.26	12.18	10.62	11.57
Velocity of Flow (Vc) 4/	Ft./Sec.	8.2	8.9	8.9	8.9	8.0	8.7	9.0
Discharge Rate 4/	C.F.S.	889	4,611	2,840	2,813	627	6,359	5,723
Maximum Water Surface Elevation 1/ 4/	Foot	576.0	598.5	596.0	618.0	586.4	561.5	621.0
Principal Spillway								
Capacity - Maximum	C.F.S.	9	21	25	36	5	121	48 5/
Sediment Pool Elevation 1/	Foot	561.6	577.3	577.8	600.2	571.3	548.1	598.3
Capacity Equivalents 1/								
Sediment Volume	Inch	0.64	0.51	0.52	0.57	0.59	0.60	0.63
Recreation Pool	Inch	-	-	-	-	-	-	-
Sediment in Detention Pool	Inch	0.12	0.09	0.10	0.09	0.11	0.12	0.12
Detention Volume	Inch	5.24	6.32	5.12	4.96	5.35	5.07	5.05
Spillway Storage	Inch	3.32	2.68	2.39	3.01	3.52	4.25	2.55
Class of Structure		A	A	A	A	A	A	A

(See footnotes on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Lower Clear Boggy Creek Watershed, Oklahoma

Item	Unit	STRUCTURE NUMBER 26	27	28	29	30	31	32	Total
Drainage Area 1/	Sq.Mi.	3.82	1.11	0.59	2.03	0.75	8.95	8.04	103.58
Storage Capacity 1/									
Sediment Pool	Ac.Ft.	124	37	22	91	32	401	279	3,942
Recreation Pool	Ac.Ft.	-	-	-	-	-	-	-	2,011
Sediment in Detention Pool	Ac.Ft.	24	7	5	17	6	76	64	769
Floodwater Detention Pool	Ac.Ft.	1,043	305	165	567	212	2,363	2,114	29,880
Total	Ac.Ft.	1,191	349	192	675	250	2,840	2,457	36,602
Surface Area 1/									
Sediment Pool	Acre	33	15	6	19	9	86	64	353
Recreation Pool	Acre	-	-	-	-	-	-	-	360
Detention Pool	Acre	136	49	23	70	29	238	243	3,651
Volume of Fill	Cu.Yd.	93,300	24,300	40,300	59,000	44,000	115,000	106,600	2,133,600
Elevation Top of Dam 1/	Foot	579.5	554.0	573.5	564.5	562.0	567.5	585.0	xxx
Maximum Height of Dam 1/	Foot	31	18	27	30	30	33	31	xxx
Emergency Spillway									
Crest Elevation 1/	Foot	575.5	550.5	570.0	560.5	558.5	563.5	581.0	xxx
Bottom Width 1/	Foot	136	62	50	90	48	218	272	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		4	4	4	4	4	4	4	xxx
Average Curve No. - Condition II		77	76	76	75	75	75	76	xxx
Emergency Spillway Hydrograph									
Storm Rainfall (6-hour)	Inch	6.34	6.64	6.73	6.50	6.70	6.03	6.08	xxx
Storm Runoff	Inch	3.78	3.94	4.02	3.71	3.88	3.30	3.45	xxx
Velocity of Flow (Vc) 4/	Ft./Sec.	0	0	0	0	0	0	0	xxx
Discharge Rate 4/	C.F.S.	0	0	0	0	0	0	0	xxx
Maximum Water Surface Elevation 1/ 4/	Foot	-	-	-	-	-	-	-	xxx
Freeboard Hydrograph									
Storm Rainfall (6-hour)	Inch	14.57	15.26	15.49	14.94	15.41	13.86	13.97	xxx
Storm Runoff	Inch	11.51	12.03	12.25	11.57	12.03	10.53	10.78	xxx
Velocity of Flow (Vc) 4/	Ft./Sec.	8.8	8.3	7.7	8.9	8.1	8.7	8.7	xxx
Discharge Rate 4/	C.F.S.	2,648	1,040	698	1,354	754	4,192	5,213	xxx
Maximum Water Surface Elevation 1/ 4/	Foot	579.5	554.0	573.2	564.5	562.0	567.5	585.0	xxx
Principal Spillway									
Capacity - Maximum	C.F.S.	42 5/	9	5	16	6	99 5/	64	xxx
Sediment Pool Elevation 1/	Foot	562.6	540.7	557.5	548.9	546.2	549.7	566.3	xxx
Capacity Equivalents 1/									
Sediment Volume	Inch	0.61	0.62	0.71	0.84	0.80	0.84	0.65	xxx
Recreation Pool	Inch	-	-	-	-	-	-	-	xxx
Sediment in Detention Pool	Inch	0.12	0.12	0.14	0.16	0.15	0.16	0.15	xxx
Detention Volume	Inch	5.12	5.15	5.25	5.24	5.30	4.95	4.93	xxx
Spillway Storage	Inch	3.06	3.03	2.98	2.26	3.00	2.65	2.74	xxx
Class of Structure		A	A	A	A	A	A	A	

1/ Subject to minor adjustment in the final design stage. Major changes will require a work plan revision.
2/ Exclusive of watershed from which runoff is controlled by other structures in series.
3/ Based on regional analysis of gaged runoff - in all cases minimum requirements set forth in Washington Engineering Memorandum SCS-27.
4/ Maximum during passage of hydrograph.
5/ 3 csm added for base flow.
6/ Partially estimated data.

TABLE 3A - STRUCUTRE DATA

CHANNELS

Lower Clear Boggy Creek Watershed, Oklahoma

Channel Designation	Station Numbering 1/ Station (100 ft.)	Station (100 ft.)	Required Channel Capacity 2/ (c.f.s.)	Planned Channel Capacity (c.f.s.)	Average Bottom Width (feet)	Average Side Slope	Average Design Depth (feet)	Average Fall (ft./sec.)	Velocity in Channel at Designed Depth (ft./sec.)	Volume of Elevation (1000 cu. yds.)
Channel C-1										
Main	0+00	71+00	37	42	18	4:1	1.4	0.001	1.27	29.9
	90+00	107+55	42	47	18	4:1	1.5	0.001	1.32	2.4
Lateral	0+00	18+35 (26+80 of Main)	16	17	18	4:1	0.7	0.002	1.20	4.2

1/ Station numbered upper end. Station numbers include only sections requiring construction.

2/ Channel designed to only carry release from floodwater retarding structures.

November 1969

TABLE 4 - ANNUAL COST

Lower Clear Boggy Creek Watershed, Oklahoma

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Floodwater Retarding Stru tures 4 through 14 and 16 through 32 with Channel C-1 and Recreational Facilities	154,330	53,152	207,482
Project Administration	6,278		6,278
TOTAL	160,608	53,152	213,760

1/ Price Base: Installation 1967, O&M adjusted normalized prices.

2/ 100 years at 3.25 percent interest.

November 1969

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD REDUCTION BENEFITS

Lower Clear Boggy Creek Watershed, Oklahoma

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crops and Pasture	111,760	25,999	85,761
Other Agricultural	20,483	261	20,222
Nonagricultural (Roads and Bridges)	2,983	270	2,713
Subtotal	135,226	26,530	108,696
Sediment			
Overbank Deposition	28,636	9,519	19,117
Erosion			
Flood Plain	16,903	1,104	15,799
Indirect	18,096	3,719	14,377
TOTAL	198,861	40,872	157,9892/

1/ Price Base: Adjusted normalized prices.

2/ Included are flood reduction benefits assigned as follows: to the Delaware Creek Watershed, $16,541; to the Leader-Middle Clear Boggy Creek Watershed, $45,372; and to the Caney Creek Watershed, $1,238.

November 1969

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Lower Clear Boggy Creek Watershed, Oklahoma
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/							Average Annual Cost 3/	Benefit Cost Ratio
	Damage 2/ Reduction	Changed Land Use Agricultural	Recreational	Outside Project Sediment Reduction to Boswell Reservoir	Secondary Benefits	Redevelopment	Total		
Floodwater Retarding Structures 4 through 14 and 16 through 32 with Channel C-1 and Recreational Facilities	84,812	28,174	185,418	5,325	22,700	28,000	354,429	207,482	1.7:1.0
Project Administration								6,278	
GRAND TOTAL	84,812	28,174	185,418	5,325	22,700	28,000	354,429	213,760	1.7:1.0

1/ Price Base: Adjusted normalized prices.

2/ In addition, it is estimated that land treatment measures will provide annual flood reduction benefits of $10,026 in the watershed, and $2,637 to the Boswell Reservoir.

3/ From table 4.

November 1969

INVESTIGATIONS AND ANALYSES

Soil and Cover Conditions

The soil-cover conditions were determined from existing work unit records and field inspection. Additional information used for verification of soil-cover conditions was obtained from detailed sediment source studies above structure sites.

Land Use and Treatment Needs

The land use on the upland was determined from existing work unit records and from detailed sediment source studies on 25 percent of the total drainage area behind proposed floodwater retarding structures. The land use of the flood plain was planimetered from the flood plain map developed during the hydrologic and economic investigations.

The land treatment measures, based on current needs, which remain to be applied in the watershed and which contribute directly to flood prevention, were estimated. The quantities of these measures which will be applied during the project installation period are shown in table 1. Land treatment measures to be applied with assistance from Soil Conservation Service technicians are identified in accordance with the terminology in the Soil Conservation Service National Records and Reports Handbook. Bureau of Indian Affairs terminology was used for the other measures. The hydraulic, hydrologic, sedimentation, and economic investigations provided data on the effects of these measures in terms of the reduction of flood damages resulting from such treatment. Although measurable benefits would result from application of these needed land treatment measures, it was apparent that structural measures would be needed to attain the degree of watershed protection and flood damage reduction desired.

Project Formulation

Feasible structural measures were determined. The study made and the procedures used in that determination were as follows:

1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads and other pertinent information. A stereoscopic study of consecutive 4-inch aerial photographs was used to locate possible floodwater retarding structure sites, the limits and the area of the flood plain and points where valley cross sections should be taken for the determination of hydraulic characteristics and for flood routing purposes. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were surveyed at the selection locations (figure 5). Data developed from these cross sections permitted the computation of peak discharge-damage relationships for various flood flows. A map of the flood plain was prepared showing land use, cross section locations and other pertinent information.

2. A field examination was made of all possible floodwater retarding structure sites previously located stereoscopically. Sites which did not show good storage possibilities or which would inundate highways or expensive improvements which would make the cost so high that the site would not be economically feasible were dropped from further consideration. A system of floodwater retarding structures was selected from the remaining sites for further consideration and detailed survey. Plans of a floodwater retarding structure, typical of those planned for the watershed, are illustrated by figures 3 and 3A.

3. Damages resulting from floodwater, sediment, and erosion were determined from damage schedules and surveys of the flood plain area. Reduction in these damages by the installation of floodwater retarding structures was estimated on the basis of reduction of area and depth of inundation as determined by flood routings. Calculations of flood damages were made according to flood routings without project and with proposed works of improvement installed. Benefits accruing to the watershed as a result of upstream watershed projects, assuming full participation of each project, were assigned as shown in footnote 2 of table 5. The remaining benefits were allocated to individual measures or groups of interrelated measures on the basis of the effect of each on reduction of damages. Alternate systems of structures were evaluated and the combination selected which met project objectives at lowest cost.

4. The combined project for flood prevention, including land treatment measures and floodwater retarding structures was evaluated. Studies were made and data developed to show the total cost of each type of measure and the portion of the cost to be borne by the participants. A summation of the total costs for all planned measures is shown in table 1. A second cost table was developed to show the annual installation cost, annual maintenance cost, and total annual cost of the structural measures (table 4.)

Engineering Investigations

Tentative locations for 49 floodwater retarding structures were selected by stereoscopic study of aerial photographs and field inspection. A total of 29 structures are included in this work plan.

1. Topographic maps with 4-foot contour intervals and a scale of 1 inch = 200 feet were developed from engineering surveys of the pool area of each site.

   The height of the dams and the size of the pools were determined by the storage volume needed to detain the runoff from the design storm and to provide the additional storage needed for sediment.

2. Structure data tables were developed to show the drainage area, storage capacity planned for floodwater detention and sediment storage, release rate of the principal spillway, emergency spillway capacity, area inundated by the sediment and detention pools, and other pertinent data for each floodwater detention structure (table 3).

3. The minimum floodwater detention capacity required for each class (a) floodwater retarding structure is that needed to detain temporarily the runoff from a 6-hour, 25-year frequency storm. Where storage capacity was available and it was economically feasible to remove physical obstacles, sufficient additional detention capacity is planned to detain the expected runoff from a 25-year frequency storm event, as determined by a regional analysis of stream gage records in areas of similar geologic formation, topography, and average annual rainfall. Due to excessive costs for relocating roads and farmsteads, site 9 detains less than gaged runoff.

4. Estimates were made of the volume of fill in the dams and the costs of the structures. Engineer's estimate of the structure costs ranged from $0.70 per cubic yard to $0.83 per cubic yard, depending on availability of fill material, difficulty of keying into rock abutments, the grouting of solution channels necessary to insure the stability of the structure, and amount of rock excavation required in emergency spillways. Additional allowances were added for the high cost of clearing in the densely timbered areas and for the construction of outlet channels.

   Checks were made to determine if additional detention storage would reduce the overall cost of the embankment, cutoff, and emergency spillway. The percent chance of use of the emergency spillway, as shown in table 3, is based on a regional analysis of gaged runoff. Most of the structures are designed to detain temporarily the gaged runoff having a 25-year frequency average occurrence for the class (a) structure. All detention volumes exceed the minimum requirements set forth in Engineering Memorandum SCS-27.

   Cost distribution tables were developed (table 2).

Hydraulic and Hydrologic Investigations

The following steps were taken as part of the hydrologic investigations and determinations:

1. Basic meteorologic and hydrologic data were tabulated from climatological bulletins, U.S. Geological Survey, and analyzed to determine average precipitation, the historical flood series to be used in the evaluation of the project, runoff-peak discharge relationships, and the relationship of geology, soils, and climate to runoff depth for single storm events.

2. Engineering surveys were made of channel and valley cross sections selected to represent adequately the stream hydraulics and the flood plain area. Preliminary locations for cross sections were made by stereoscopic examination of aerial photographs of the flood plain. The final locations were selected in the field giving due consideration to the needs of the economist and geologist (figure 5).

3. Precipitation records collected by the U.S. Weather Bureau at Sulphur, Farris, Ada, Pontotoc, Caney, and Durant were used to prepare a comulative departure from normal precipitation graph on Lower Clear Boggy Creek watershed. These data, plus data from upstream gages, indicated that 1942 through 1961 was a normal rainfall-runoff period.

4. The present hydrologic condition of the watershed was determined by a sampling of the watershed, geologic studies and correlation of flood flows through the Clear Boggy River gage near Caney, Oklahoma. The future hydrologic condition of the watershed was determined from information furnished by the work unit conservationists concerning the change in land use that could be expected with an accelerated land treatment program during the installation period. Runoff curve numbers were computed from these soil-cover complex data. The 1942-1961 flood series was developed from recorded flood peaks at the Clear Boggy River near Caney, Oklahoma, and rainfall records from gages described in paragraph 3.

5. A depth-frequency curve was prepared by log probability analysis of runoff data from Clear Boggy River gage. It was found that the 24-hour, 25-year frequency storm would yield a runoff of 4.75 inches for the Lower Clear Boggy Creek watershed. This amount of runoff was routed to determine the maximum flood plain area for use in the computations of damages and benefits.

6. Cross-section rating curves were computed from field survey data collected as described in item 2 above, by solving water surface profiles for various discharges.

7. The theory of maximum flood flows was used to determine the relationship of peak discharge and drainage area. The concordant flow equation was determined from reliable high-water marks left by the flood of September 1957 and from the runoff measurements at the Clear Boggy River gage. The resultant formula was $Q = 410A^{0.5}$, where Q = flow in cubic feet per second and A = area in square miles. Individual studies were made for several small drainage areas where the formula was not applicable.

8. Stage-area inundation curves were developed from field survey data for each portion of the valley represented by a cross section. Composite runoff-area inundation curves for incremental depths of flooding were developed for each evaluation reach by routing flood peaks by the concordant flow method and

summing the area flooded by depths for each portion of the valley represented by a cross section in the evaluation reach. A similar family of runoff-area inundation curves was developed to reflect the effect of the proposed system of floodwater retarding structures.

9. Determinations were made of the area by depth increments that would have been inundated by each storm in the evaluation series under conditions that would exist due to:

    a. The present conditions of the watershed.

    b. The installation of land treatment measures.

    c. The installation of land treatment measures and floodwater retarding structures.

10. A study of geologic formations and the gaged runoff from Clear Boggy River was used in determining the 25-year frequency storm runoff (5.21 inches for 1 square mile). Engineering and Watershed Planning Hydrology Memorandum No. 2 (OK-35) was used as a guide in varying flood storage with drainage area. The runoff from the 6-hour, 25-year frequency storm (Weather Bureau, Technical Publication - 40) is 3.20 inches. This amount of runoff is the minimum permissible detention storage for class (a) floodwater retarding structures.

11. The appropriate spillway design storm and storm pattern were selected from figures 3.21-1, 3.21-4 and 5, National Engineering Handbook, Section 4, Supplement A, in accordance with criteria contained in Engineering Memorandum SCS-27.

    Spillway design storm hydrographs were developed for each of the floodwater retarding structures by the distribution graph method. The combination of emergency spillway width, depth, and elevation for the most economical structure was estimated by an empirical equation. The final design was obtained by the Goodrich flood routing method described on page 5.8-12 of the National Engineering Handbook, Section 5, for all sites in series and sites having special design problems. Principal spillway capacities (low stage) were set so as to result in no flooding of bottom lands from releases during prolonged flows. A study of the channel capacity of Clear Boggy River was made. Each of the six watersheds on which it was expected a work plan would be developed was allocated its proportionate share of Clear Boggy River channel capacity. This was based on the estimated structural control and the area of the watershed.

12. The surface runoff from a 24-hour, 25-year frequency storm under present conditions would be 4.75 inches. This would cause a peak discharge of 50,400 c.f.s. at the reference valley section 22 (figure 5). After the installation of the

land treatment measures proposed in this plan, the runoff from the watershed would be reduced to 4.67 inches. After the installation and full functioning of the land treatment and structural measures, the peak discharge from this storm would be reduced to 19,350 c.f.s. at the reference valley section.

13. Flooding was studied on the Lower Clear Boggy Creek as if the water level was at the top of the 10-year frequency pool of the proposed Boswell Reservoir. A similar study was also made above the 10-year pool frequency of the presently authorized Boswell Reservoir.

Sedimentation Investigations

The field surveys of the sedimentation problems of the Lower Clear Boggy Creek watershed were made in accordance with the Geologic Section of the Oklahoma Planning Handbook and Technical Release No. 12, "Procedure for Computing Sediment Requirements for Retarding Reservoirs" (September 1959).

Field studies included reconnaisance surveys of geology and physiography, studies of overbank sediment deposits, flood plain scour, streambank erosion and the nature of the channels and valleys on or near the valley cross sections. Borings were made along or near 35 percent of the valley sections to determine the extent, depth, and texture of sediment deposits. Damage was assessed on the basis of depth and texture of sediment and the resultant effect on productivity. In preparation of the report, summaries of all the above findings were used by the economist as the basis for calculating monetary damages.

Sediment Source Studies

Sediment sources were investigated in the drainage areas of nine planned floodwater retarding structures. Procedures outlined in the Oklahoma Watershed Planning Handbook and Technical Release No. 12 were followed. Using results of these investigations, estimates were made of present and future sediment yields to each of the floodwater retarding structure sites.

The estimate of sediment derived from sheet erosion was taken from planimetric data gathered from field studies and stereoscopic inspection of aerial photographs on approximately 40 percent of the drainage area above sites. Erosion rates were calculated separately for each soil unit, slope, and cover condition in the drainage areas.

From these studies, the total sediment deposited annually in all the proposed floodwater retarding structures was calculated to be 94.22 acre-feet. The average annual rate of sediment deposition in the structures is 0.87 acre-foot per square mile. It is estimated that 85 percent of the total sediment produced above the structures is derived from sheet erosion and 15 percent from gully and streambank erosion. Factors affecting future sediment yields such as the destruction of cover by fire, deterioration due to droughts, and possible changes in land use were considered in calculating sediment storage capacity for each individual structure.

The annual rate of sediment deposition in the authorized Boswell Reservoir was calculated without project and with the project installed. The results of the studies made for determining sediment storage requirements for floodwater retarding structures were used to make this calculation. Studies made earlier on Upper Clear Boggy, Leader-Middle Clear Boggy, Delaware, and Caney Creek watersheds also were used. The estimated annual sediment production rate from the entire drainage area above the Boswell site was considered in arriving at the rate for Lower Clear Boggy Creek watershed.

Geologic Investigations

The exposed rocks in the watershed are sandstones, shales, limestones, dolomites, and granite. Ages range from Pre-Cambrian to Cretaceous. About one-half of the watershed is underlain by the Paluxy sand of Cretaceous age. This sandstone is poorly cemented and ranges in color from white to red. It occurs in the middle part of the watershed. The youngest rocks in the watershed are the limestones and shales of the Washita group which occur in the south part of the watershed. The limestones are gray to blue-gray in color, partly crystalline, and very fossiliferous in places. The shales are heavy and range in color from dark gray to purple.

The goodland limestone crops out in a narrow, winding bank a few hundred feet to one mile in width across the southern part of the watershed. This limestone is gray, moderately hard, and fossiliferous in places. Buff to brown colored sandstones and gray and brown shales of the Atoka formation crop out over a large area in the north part of the watershed.

Small areas of Wapanucka limestone and Springer shale of Pennsylvania age, Caney shale of Mississippian age, and Arbuckle limestones and dolomites of Cambrian age crop out in the northwestern part of the watershed. A few small areas of the Pre-Cambrian Tishomingo granite occur in the extreme western part of the area.

Preliminary geologic investigations were made at all proposed sites. Investigations included studies of rock types and structure, valley slope characteristics, stream channel conditions, and availability of suitable fill material and foundation conditions. The geologic formations and the sites in each formation are:

Washita Group	-	Site 4
Goodland	-	Site 4
Paluxy	-	Sites 5, 6, 7, 8, 9, 10, 11, 12, 28, 29, 30, 31, and 32
Atoka	-	Sites 13, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, and 30

Wapanucka	-	Site 14
Tishomingo Granite	-	Sites 10, 16, and 17

Sites 4 and 14 are on limestone and will require rock excavation in emergency spillway areas. Site 29 will probably require some excavation of sandstone in the spillway area. Foundation preparations at sites 10, 16, and 17 will require removal of 100-200 cubic yards of granite boulders. Dams and emergency spillways on these three sites can be located to avoid much rock excavation in granite.

All of the sites on the Paluxy sand may need foundation drains. Detailed geologic investigation may reveal sandy foundation conditions, which will necessitate foundation drains at some of the sites on the Atoka formation.

Various geologic conditions at each site are described on Form SCS-375, "Preliminary Geologic Investigation of Dam Sites". These are on file as a part of work plan substantiating data. Detailed investigations and laboratory testing will be done prior to final design of structures.

Economic Investigations

Damage schedules covering 61 percent of the flood plain of the watershed were obtained from landowners and operators in the area. These schedules covered land use and crop distribution, yield data, and historical information on flooding and flood damages. Analysis of the information contained in the schedules and supplemental data from other similar watersheds formed the basis for determining damage rates for depth and season of flooding. In calculating crop and pasture damages, expenses saved, such as the cost of harvesting, were deducted from the gross damage. The applicable damage rates were applied to the floods of the historical series. The damage was adjusted to account for the effect of recurrent flooding when more than one event occurred within a single crop year.

The flood plain land use was mapped in the field. Estimates of normal yields were based on data obtained from the schedules, supplemented by information obtained from soil technicians and other agricultural workers in the area.

The monetary value of the physical damage to the flood plain from scour and deposition of sediment was based on the value of production lost. This estimate took into account the lag in recovery of productivity and the cost of farm operations. Damage to other agricultural property, such as fences, livestock, levees, and farm equipment was estimated from analysis of schedules, using costs prevailing in that area, correlated with sizes of floods.

Damage to roads and bridges is the main item of nonagricultural damage in this watershed. County commissioners and other residents of the watershed supplied information on these damages.

The indirect damages calculated are those accruing primarily from disruption of travel. Local residents and businessmen provided information on

this type of damage. On the basis of the information, indirect damages were estimated at 10 percent of direct damages.

Floodwater, scour, and sediment damages were calculated without project conditions and with conditions that will prevail after installation of each class of measures included in the project. The difference between average annual damages at the time of initiation of each class of measures and those expected after its installation constitutes the benefit assigned to that group through reduction of damage.

Benefits from reduction of crop and pasture damages and flood plain scour resulted from the combined effects of reduction in area inundated and reduced depth of inundation. Estimated reductions in the area of sediment production and in acreage flooded after installation of each class of measure account for benefits from reduction of valley sediment damage.

Areas that will be inundated by the sediment and detention pools of floodwater retarding structures were excluded from the damage appraisal. Production to be lost in these areas after installation of the project was compared with the appraised value of the sites. In this analysis, it was considered that there would be no production in the sediment pools. The land covered by the detention pools was assumed to be converted to grassland under project conditions. Since the value of the easement exceeded the value of production lost, plus the negative secondary benefits therefrom, the easement value was used in economic justification.

Although downstream benefits were not needed for project justification, the sediment damages and benefits to the authorized Boswell Reservoir were evaluated and included. The straight line evaluation method described in Chapter 3 of the Economic Guide was used in making this evaluation.

Damages in the Lower Clear Boggy Creek watershed are affected by floods in the Upper Clear Boggy, Leader-Middle Clear Boggy, Delaware, and Caney Creek watersheds. Damages were assigned in proportion to the estimated peak flows contributed by each watershed at the damage centers. Consideration also was given to the proposed floodwater retarding structures in Lower Clear Boggy Creek watershed.

The portion of these benefits contributed by other upstream projects have been assigned to the areas which produced them.

Determination of Annual Benefits from Restoration of Former Productivity and Changed Land Use

During field investigations, farmers were asked what changes had been made in the use of their flood plain land as a result of past flooding. They also were asked what changes they would make in their use of the flood plain if flooding was reduced 50 percent.

Most of the farmers in the watershed indicated they would like to grow alfalfa or increase their acreage of alfalfa if flooding was reduced. Since the primary agricultural enterprise of the watershed is livestock farming, there is a good demand for alfalfa hay. Yields of alfalfa are

high. Alfalfa is generally cut four times and a fifth cutting is sometimes possible. The net return per acre from alfalfa is higher than for any other crop grown--higher even than allotment crops such as cotton and peanuts. A number of farmers said they would shift their peanut and cotton allotments to bottom lands if the risk of flooding was reduced.

The soils of the flood plain are fertile, and for the most part permeable to slowly permeable. Good yields may be expected from most crops. Tame pastures have a high carrying capacity.

Under present conditions, about 40 percent of the flood plain is wooded. A large portion of such areas is in the process of being cleared now, in anticipation of the installation of flood protection measures.

Tabulation and analysis of responses on schedules provided a partial basis for estimating the benefits from restoration of flood plain land to its former productivity and from changed land use in the flood plain. Also considered in this analysis were the size and location of areas affected, type of farming in these areas, the productivity of the land, existence of available markets, managerial skill of the operators, the reduction in frequency of flooding, and similar factors.

It was assumed that these benefits would be confined to land that would be flooded on the average of not more than once in three years after installation of the project. Costs associated with these changes, such as clearing of the timber, were deducted from the benefits. Capital costs of this were amortized over a 50-year period at 6 percent. An allowance was made for increased overhead and taxes. The additional damage to the higher value production by the remaining floods was deducted.

Benefits from restoration of former productivity and changed land use have been discounted to present worth on the assumption of a 10-year lag in accrual.

Supplemental Studies

Supplemental studies were made below sites where the flood plain acres will be reduced by raising the flood pool elevation in the authorized Boswell Reservoir. The average benefits per acre was used to arrive at the benefits for the acres below these sites. It was determined that the flood plain acres below these sites would be reduced to the extent that these sites would no longer be economically feasible.

Additional studies of small sites were made. These small sites would not reduce flooding sufficiently to justify the cost of construction.

All of the costs and benefits from Units A and C were deducted from table 6 of the original plan, and the benefits from Unit B were adjusted in proportion to the amount of flood plain protected.

Recreational Benefits

The Oklahoma Industrial Development and Park Department made a study of recreational needs for the Lower Clear Boggy Recreational Development. This study was based on needs as set out in the State comprehensive outdoor recreational plan. Studies and recommendations made by the Oklahoma Industrial Development and Park Department were used to determine the number of visitors along with other secondary data and field surveys. "Using the Designed Facilities as a Guide for Predicting Visitor Use" by Ross Miller, Recreational Specialist, E&WP Unit, Soil Conservation Service, Fort Worth, Texas, was the guide for determining the average annual visitors.

The peak load was based on the instantaneous visitor load. The average activity occasions per week was determined for a 13-week period and for the off-season period and evaluated at $1.50 per activity occasion.

Redevelopment Benefits

The basis for determination of the amount of employment the installation of the structural measures will furnish unemployed and underemployed labor was based on data collected in interviews with contractors of similar projects by Service personnel. These data indicated that local labor costs in the project area approximate 14 percent of the construction cost. This percent of the value for structural measures was amortized over 50 years at 3 1/4 percent interest and converted to redevelopment benefits. The value of local labor employed in operation and maintenance over a 20-year period was converted to an average value for the project life and used as a redevelopment benefit.

Secondary Benefits

Secondary benefits, the net increase in the value of goods and services generated by the project, will be realized by workers, processors, and business establishments in the trade area. The evaluation of these benefits was limited to those which will occur locally as a result of processing and distribution of agricultural commodities made available by the protection afforded by the project.

Local secondary benefits were estimated to equal 10 percent of the primary benefits, with the exception of those resulting from reduction of indirect damage, plus 10 percent of the increased production expense resulting from restoration of former productivity and changed land use.

Negative secondary benefits resulting from production lost in the pool areas were estimated in a similar fashion.

Methods and Procedures

Details of the procedures used in the investigation are described in the Economic Guide for Watershed Protection and Flood Prevention (procedures for use with the historical series approach).

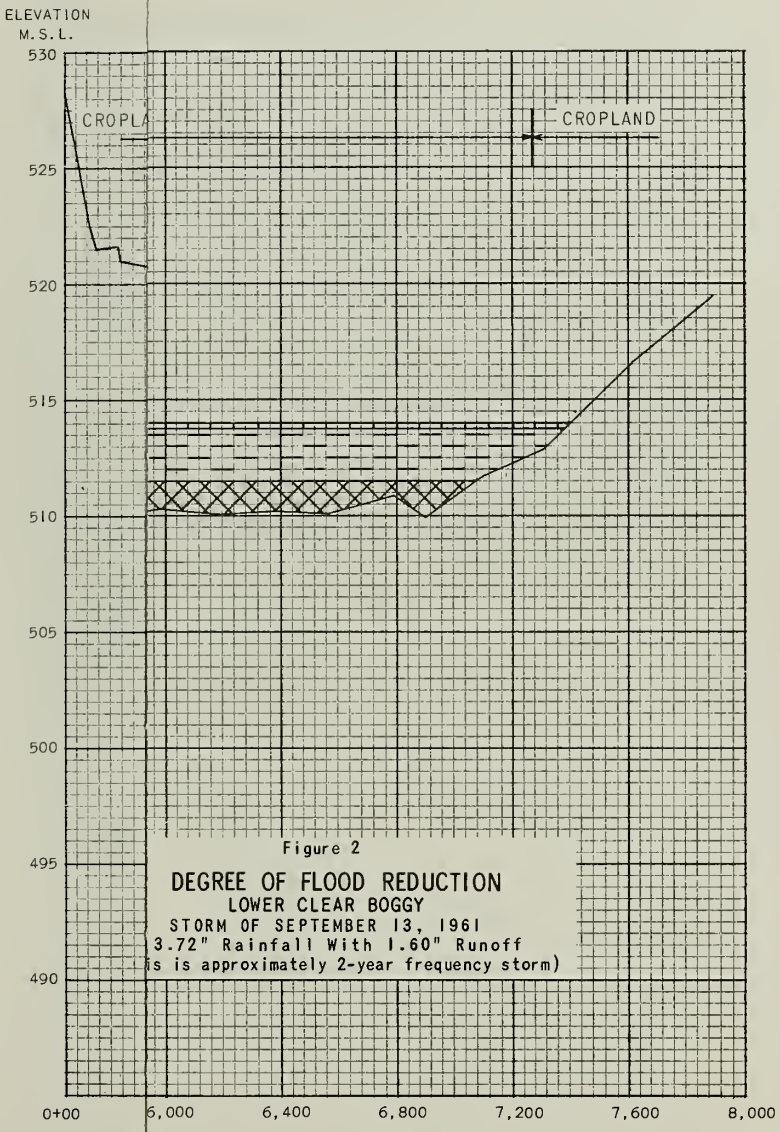


Figure 2

DEGREE OF FLOOD REDUCTION
LOWER CLEAR BOGGY
STORM OF SEPTEMBER 13, 1961
3.72" Rainfall With 1.60" Runoff
(is is approximately 2-year frequency storm)

U.S. DEPARTMEN

5-63 4-R-17915

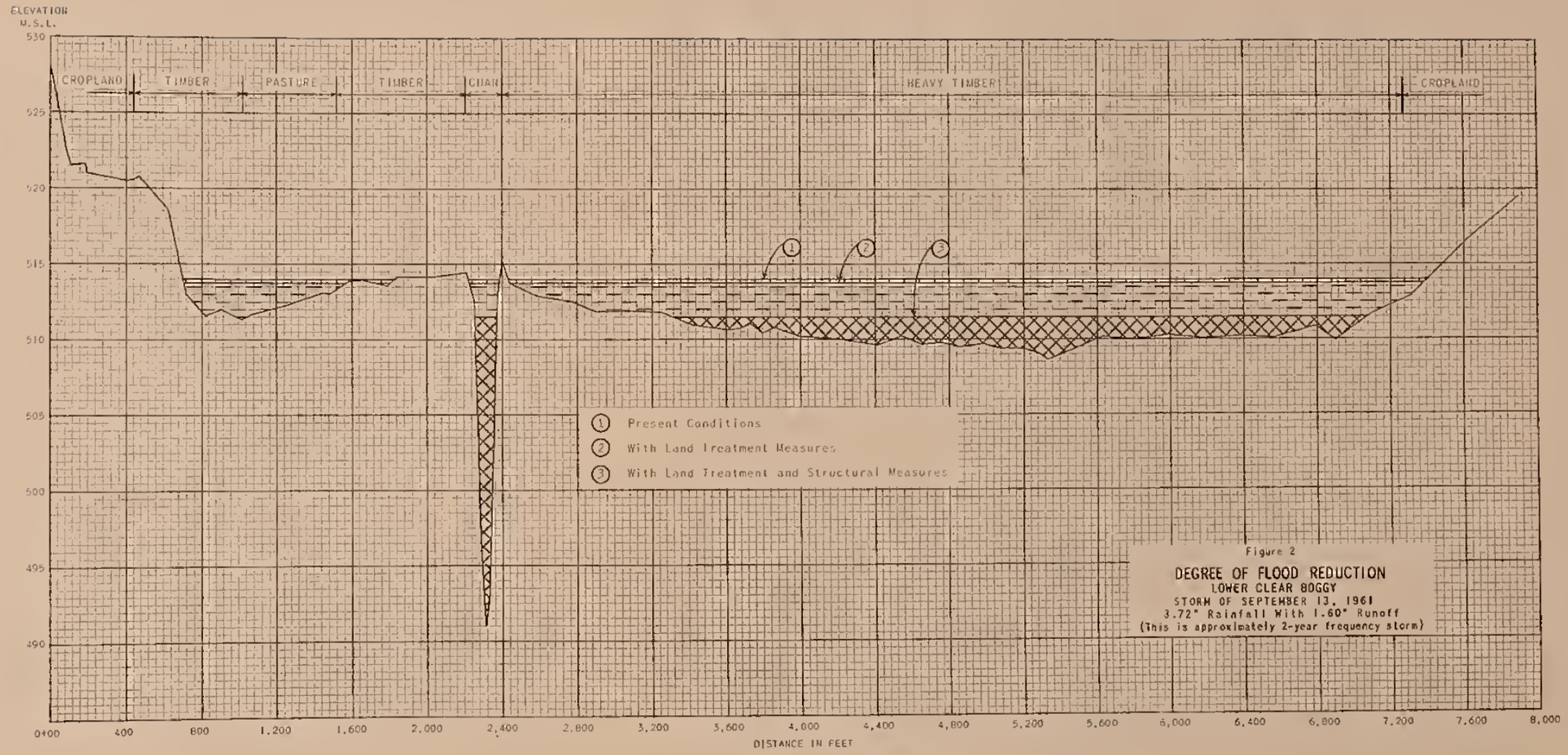


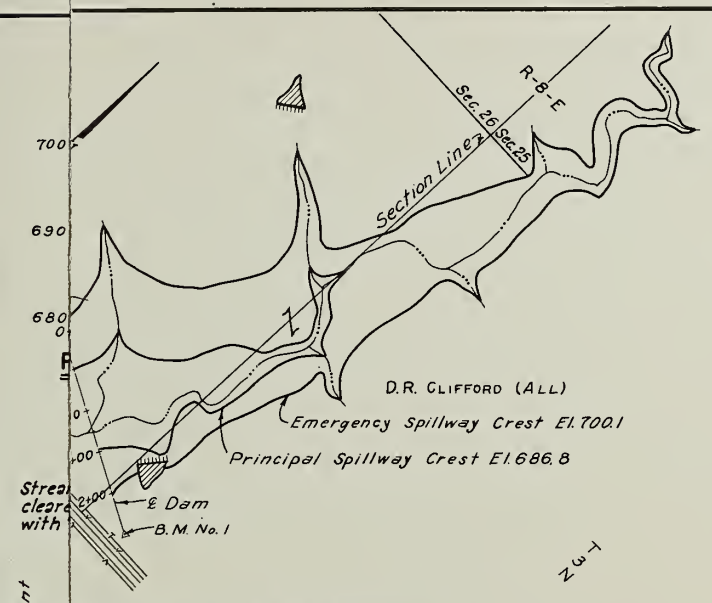
Figure 2

DEGREE OF FLOOD REDUCTION
LOWER CLEAR BOGGY
STORM OF SEPTEMBER 13, 1961
3.72" Rainfall With 1.60" Runoff
(This is approximately 2-year frequency storm)

VALLEY CROSS SECTION NO. 22

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Stillwater, Oklahoma

5-63 4-R-17915

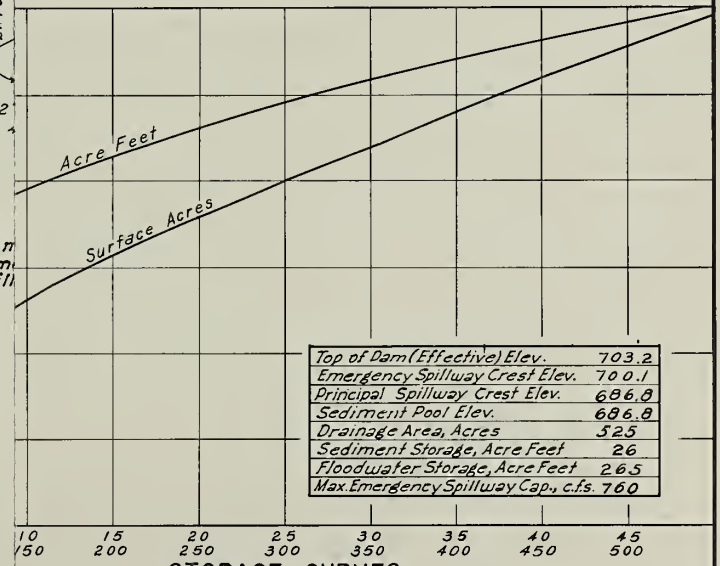


ERAL PLAN OF RESERVOIR

400 800 1200 1600

SCALE IN FEET

B.M. No.1 Concrete Monument
Sta 0+00 ℄ Dam
El. 706.686



Top of Dam (Effective) Elev.	703.2
Emergency Spillway Crest Elev.	700.1
Principal Spillway Crest Elev.	686.8
Sediment Pool Elev.	686.8
Drainage Area, Acres	525
Sediment Storage, Acre Feet	26
Floodwater Storage, Acre Feet	265
Max. Emergency Spillway Cap., c.f.s.	760

STORAGE CURVES

T 3 N

Figure 3
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

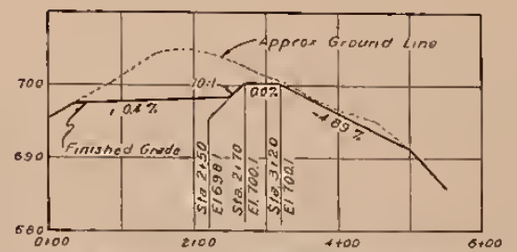
		Date
Designed	G.E.I. & K.A.M.	6-61
Drawn	G.E.I., K.A.M. & J.J.M.	7-61
Traced	J.J.M.	7-61
Checked	C.E.C. & L.W.R.	8-61

Approved by
HEAD, ENGINEERING & WATERSHED PLANNING UNIT
FORT WORTH, TEXAS

STATE CONSERVATION ENGINEER S C S
STILLWATER, OKLAHOMA

Sheet No. 2 of 8

Drawing No. 4-E-15,808

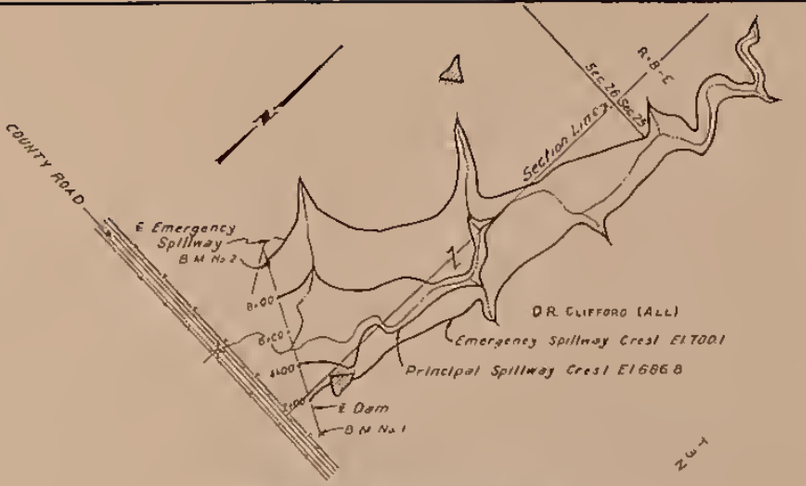


PROFILE ON ℄ OF EMERGENCY SPILLWAY

Left Dike: Sta 2+70 to E of Dam El 703.4, W=14', Approx. Sta 3+40 to Sta 5+00, H=3.3', W=12'

Right Dike: Approx. Sta 2+50 to Sta 3+20 El 703.4 Sta 3+20 to Sta 3+50 Transition. Sta 3+50 to Sta 5+00, H=3.3'.

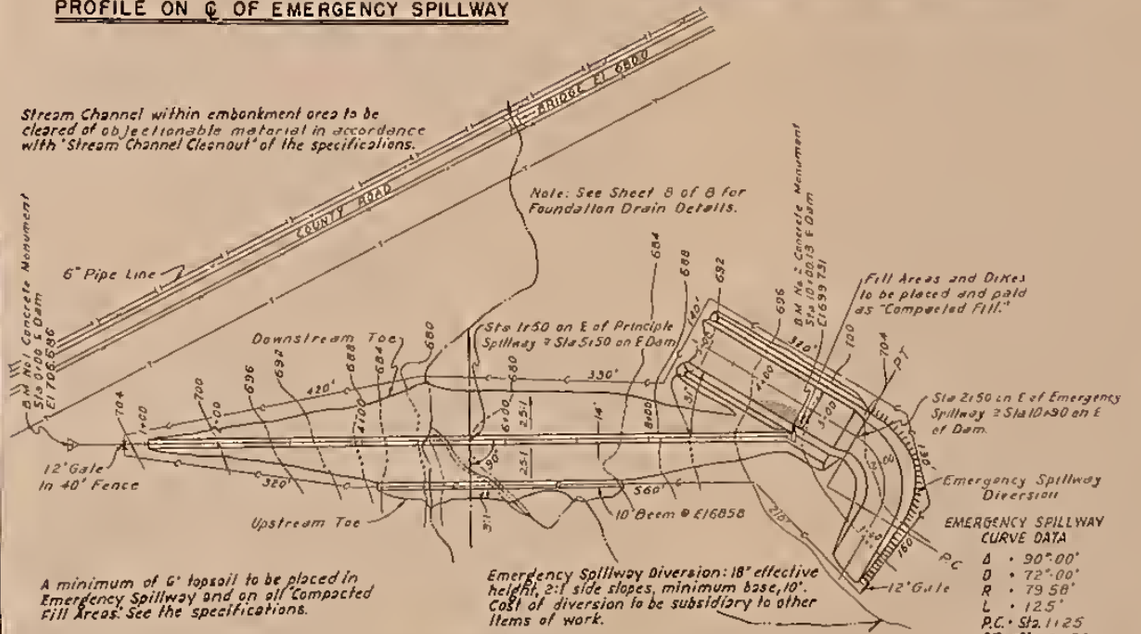
TYPICAL SECTION — EMERGENCY SPILLWAY



GENERAL PLAN OF RESERVOIR

0 400 800 1200 1600

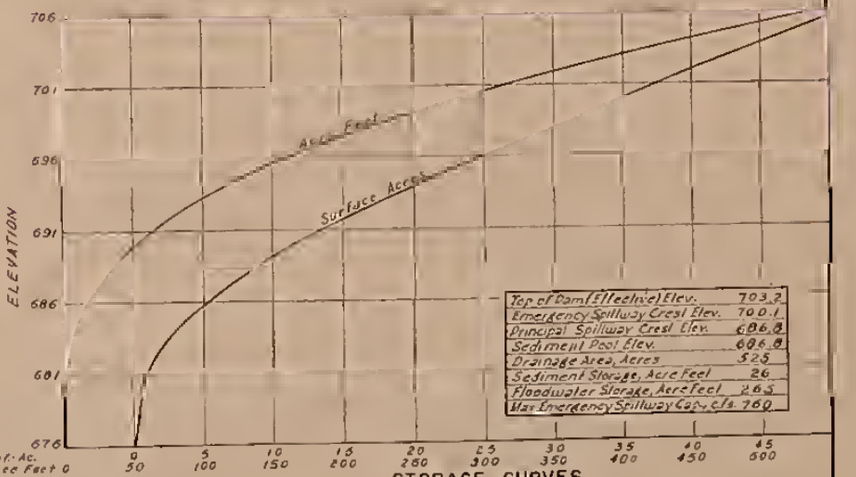
SCALE IN FEET



PLAN OF EMBANKMENT AND SPILLWAYS

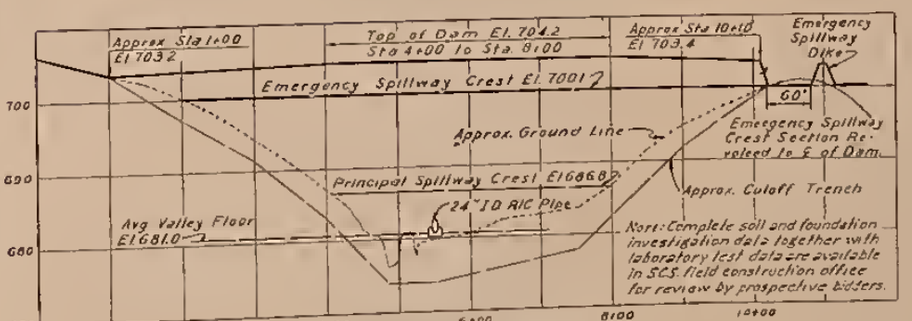
0 100 200 300 400 500

SCALE IN FEET



Top of Dam (Effective) Elev.	703.2
Emergency Spillway Crest Elev.	700.1
Principal Spillway Crest Elev.	686.8
Sediment Pool Elev.	686.8
Drainage Area, Acres	525
Sediment Storage, Acre Feet	26
Floodwater Storage, Acre-Feet	265
Max Emergency Spillway Capacity, cfs.	760

STORAGE CURVES



PROFILE ON ℄ OF DAM

Structure Located in Sec 25 and 26, T-3-N, R-8-E, Pontotoc County, Oklahoma and 12 miles West and 11 miles North of Coalgate, Coal County, Oklahoma.

VICINITY MAP

0 1 2

SCALE IN MILES

Figure 3

TYPICAL

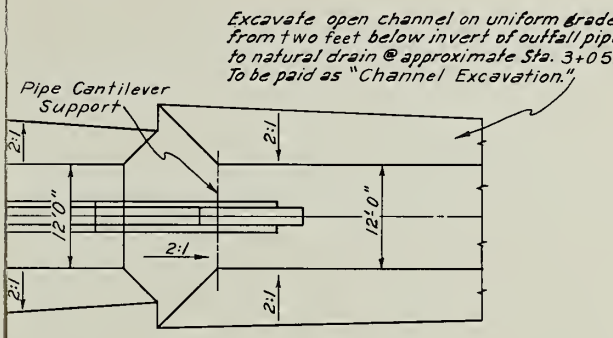
FLOODWATER RETARDING STRUCTURE

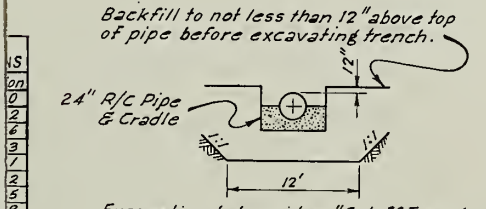
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	G.E.I. & R.A.M.	6-61	Approved by: STATE CONSERVATIONIST
Drawn	G.E.I., R.A.M. & J.J.M.	7-61	
Traced	J.J.M.	7-61	
Checked	C.E.C. & L.W.R.	8-61	Sheet No. 2 of 8 sheets

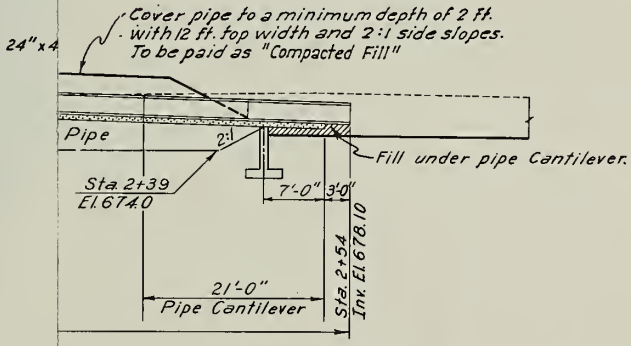
Drawing No. 4-E-15,808





Excavation to be paid as "Cutoff Trench Excavation." Backfill prior to excavating pipe trench to be paid as "Compacted Fill"

TYPICAL FOUNDATION EXCAVATION



all shown is prepared for 12 ft lengths of pipe joint. 8' or 10' pe joint may be used in the installation by laying the joints invert elevation at each joint falls on the invert grade line ed in the table. When other than 12 ft joint lengths of pipe e total length of pipe shall be that multiple of the joint that is closest to the total length shown.

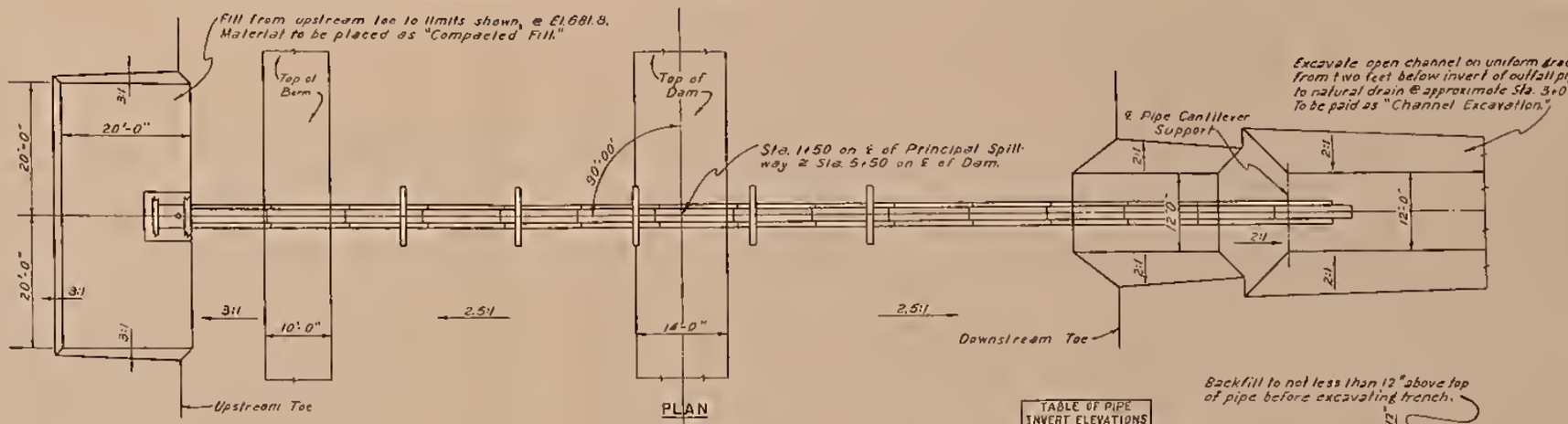
Figure 3A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE - PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	G.E.I. & K.A.M.	6-61
Drawn	G.E.I., K.A.M. & J.J.M.	7-61
Traced	J.J.M.	7-61
Checked	C.E.C. & L.W.R.	8-61

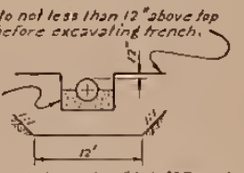
Approved by: _____
HEAD, ENGINEERING & WATERSHED PLANNING STAFF, FORT WORTH, TEXAS
STATE CONSERVATION ENGINEER, S. C. S.
STILLWATER, OKLAHOMA

Sheet No 3 of 8 | Drawing No. 4-E-15,808



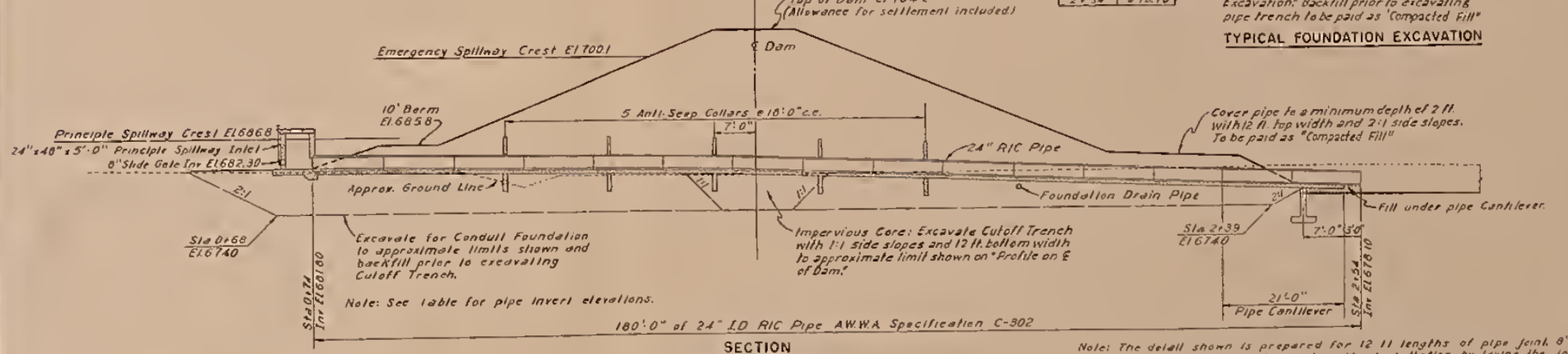
PLAN

TABLE OF PIPE INVERT ELEVATIONS	
Station	Elevation
0+74	681.80
0+98	681.52
1+22	681.14
1+46	680.73
1+70	680.27
1+94	679.43
2+18	678.95
2+30	678.58
2+54	678.10



Excavation to be paid as "Cutoff Trench Excavation." Backfill prior to excavating pipe trench to be paid as "Compacted Fill"

TYPICAL FOUNDATION EXCAVATION



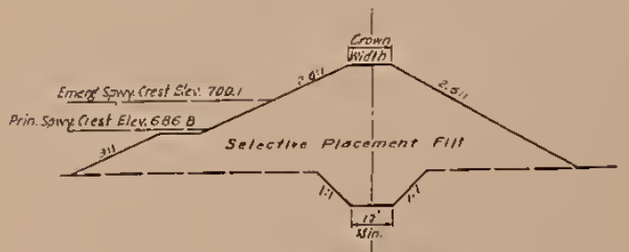
SECTION
PRINCIPAL SPILLWAY

Note: The detail shown is prepared for 12 ft lengths of pipe joint. 8' or 10' lengths of pipe joint may be used in the installation by laying the joints so that the invert elevation at each joint falls on the invert grade line as established in the table. When other than 12 ft joint lengths of pipe are used, the total length of pipe shall be that multiple of the joint length used that is closest to the total length shown.

MATERIAL PLACEMENT DATA							
SOURCE OF FILL MATERIAL			LAB TEST		COMPACTION REQUIREMENTS		Lab Curve
Location	Ave. Depth Test		Standard		Min. Dry Density	Minimum Moisture Percent	
	From	To	Max. Dry Dens.	Optim. Moist.	Lbs Per Cu. Ft		No.
Emergency Spillway	2'	7'	113.5	13.5	108.0	12.0	1
Borrow	2'	7'	116.0	13.0	110.0	12.0	2
Borrow (Shale)	5	12'	121.0	11.5	109.0	11.0	3

Notes: (1) No zoning required except that Highly Dispersed material from core trench and Borrow Curve No. 3 may be used only above El.695.0 and shall not be placed within 15 ft. measured horizontally from slopes of dam.
(2) If the material being placed in the fill contains ¾ inch or larger material in amounts differing from the percentages found in the laboratory sample, the minimum dry density and moisture requirement will be corrected for this variation.
(3) Selective Placement to be exercised in accordance with laboratory recommendations.
(4) For delineation of Borrow Zones and Borrow Area, see Geologic Investigation Sheets.

EMBANKMENT DATA



TYPICAL SECTION

Figure 3A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE - PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	GEI & KAM	6-61	Approved by: A. M.
Drawn	GEI, KAM & JJM	7-61	Title: STATE CONSERVATIONIST
Traced	JJM	7-61	
Checked	C.E.C. JLWR	8-61	Sheet No. 3 of 8

4-E-15,808

FIGURE 4

TRIBUTARY WATERSHED LOCATION

CLEAR BOGGY (CREEK) RIVER WATERSHED

IN

ATOKA, COAL, JOHNSTON, PONTOTOC, BRYAN AND CHOCTAW COUNTIES, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

REFERENCE

CARTOGRAPHIC APPROVAL | TECHNICAL APPROVAL

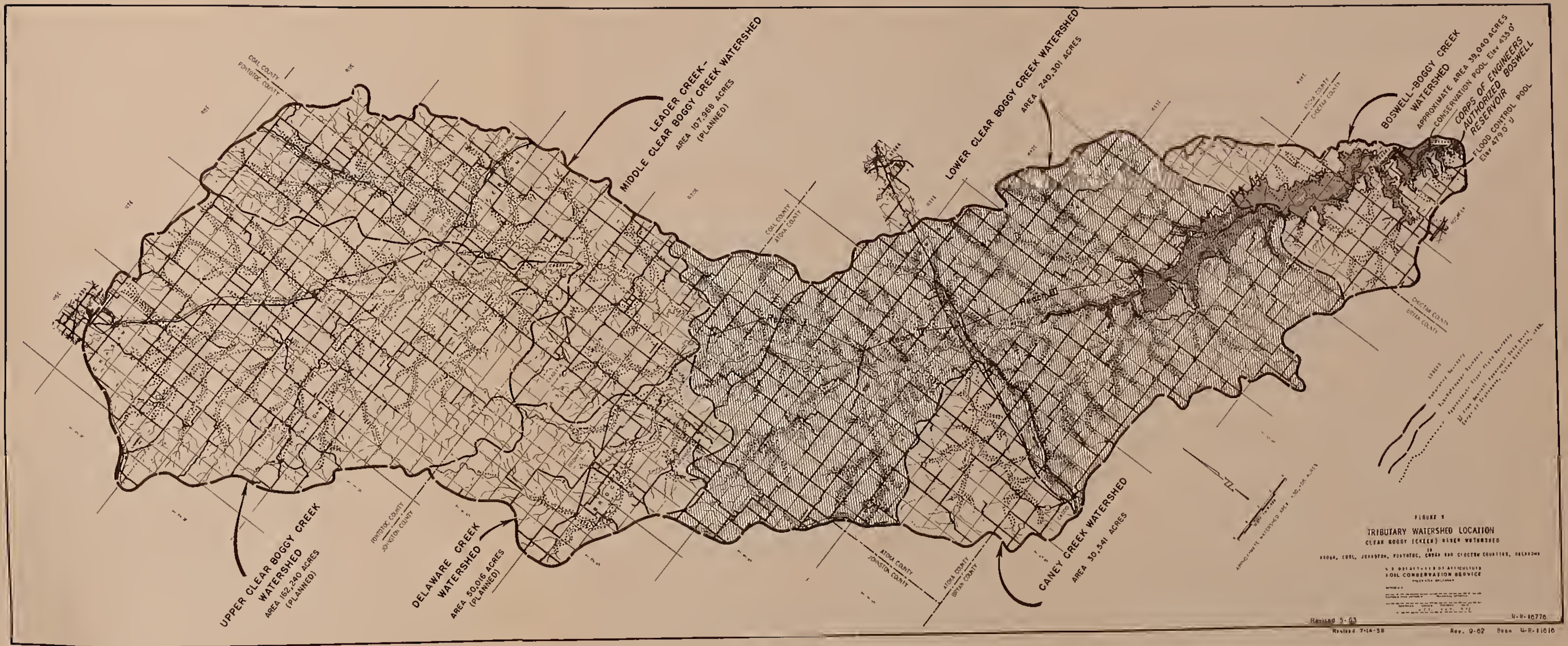
COMPILED	TRACED	CHECKED	DATE
	W.C.F.	J.W.H.	9-62

Revised 5-63

4-R-16776

Revised 7-14-58

Rev. 9-62 Base 4-R-11616


LEADER CREEK-
MIDDLE CLEAR BOGGY CREEK WATERSHED
AREA 107,968 ACRES
(PLANNED)
LOWER CLEAR BOGGY CREEK WATERSHED
AREA 240,301 ACRES
BOSWELL-BOGGY CREEK
WATERSHED
APPROXIMATE AREA 39,040 ACRES
CONSERVATION POOL Elev 435.0'
CORPS OF ENGINEERS
AUTHORIZED BOSWELL
RESERVOIR
FLOOD CONTROL POOL
Elev 479.0'
COAL COUNTY
PONTOTOC COUNTY
ATOKA COUNTY
CHOCTAW COUNTY
BRYAN COUNTY
JOHNSTON COUNTY
UPPER CLEAR BOGGY CREEK
WATERSHED
AREA 162,240 ACRES
(PLANNED)
DELAWARE CREEK
WATERSHED
AREA 50,016 ACRES
(PLANNED)
CANEY CREEK WATERSHED
AREA 30,541 ACRES
TRIBUTARY WATERSHED LOCATION
SOIL CONSERVATION SERVICE
Revised 5-63
4-R-16776
Rev. 9-62
Base 4-R-11616

LEGEND

- County Line
- Section Line
- Paved Road
- Unimproved Road
- Railroad
- Town or Community
- SWCD Boundary
- Drainage
- Watershed Boundary
- Outline of Floodwater and Sediment Damage Area
- Sediment Damage
- ss Scour Damage
- Valley Cross Section
- Evaluation Reach

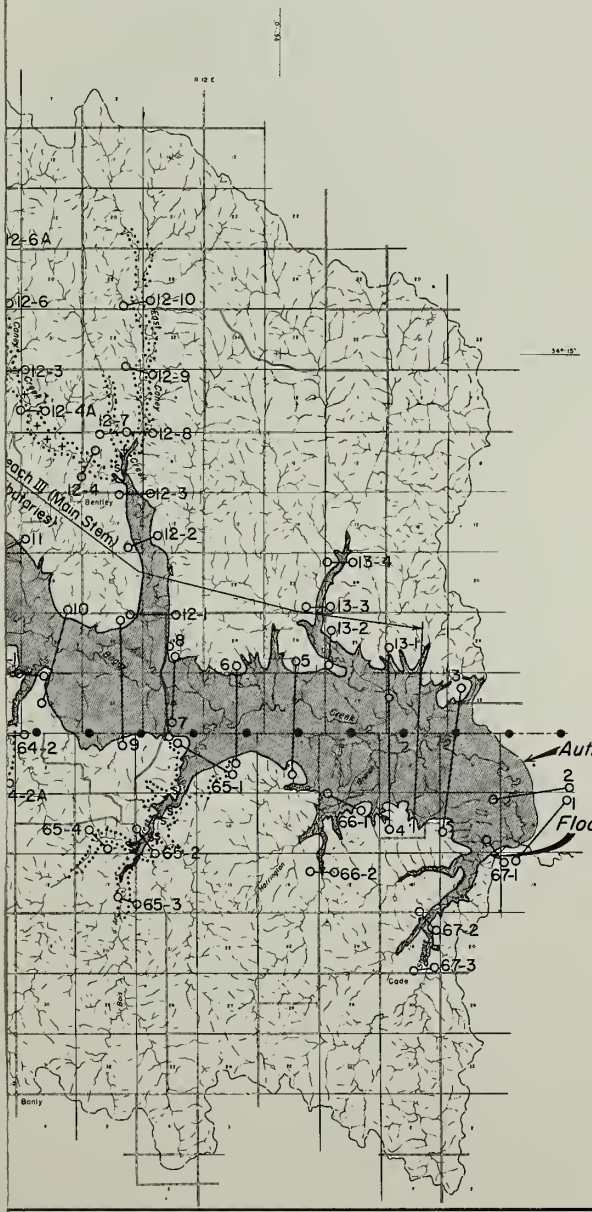


Figure 5

PROBLEM LOCATION MAP

LOWER CLEAR BOGGY CREEK WATERSHED

ATOKA, BRYAN, COAL AND JOHNSTON COUNTIES, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

0 1 2 3 Miles

Approximate Scale
1:200,500

Approximate Area 234,584 Acres

Projection Unknown Rev. 3-70 4-R-17513

Revised 2-63 4-R-16144

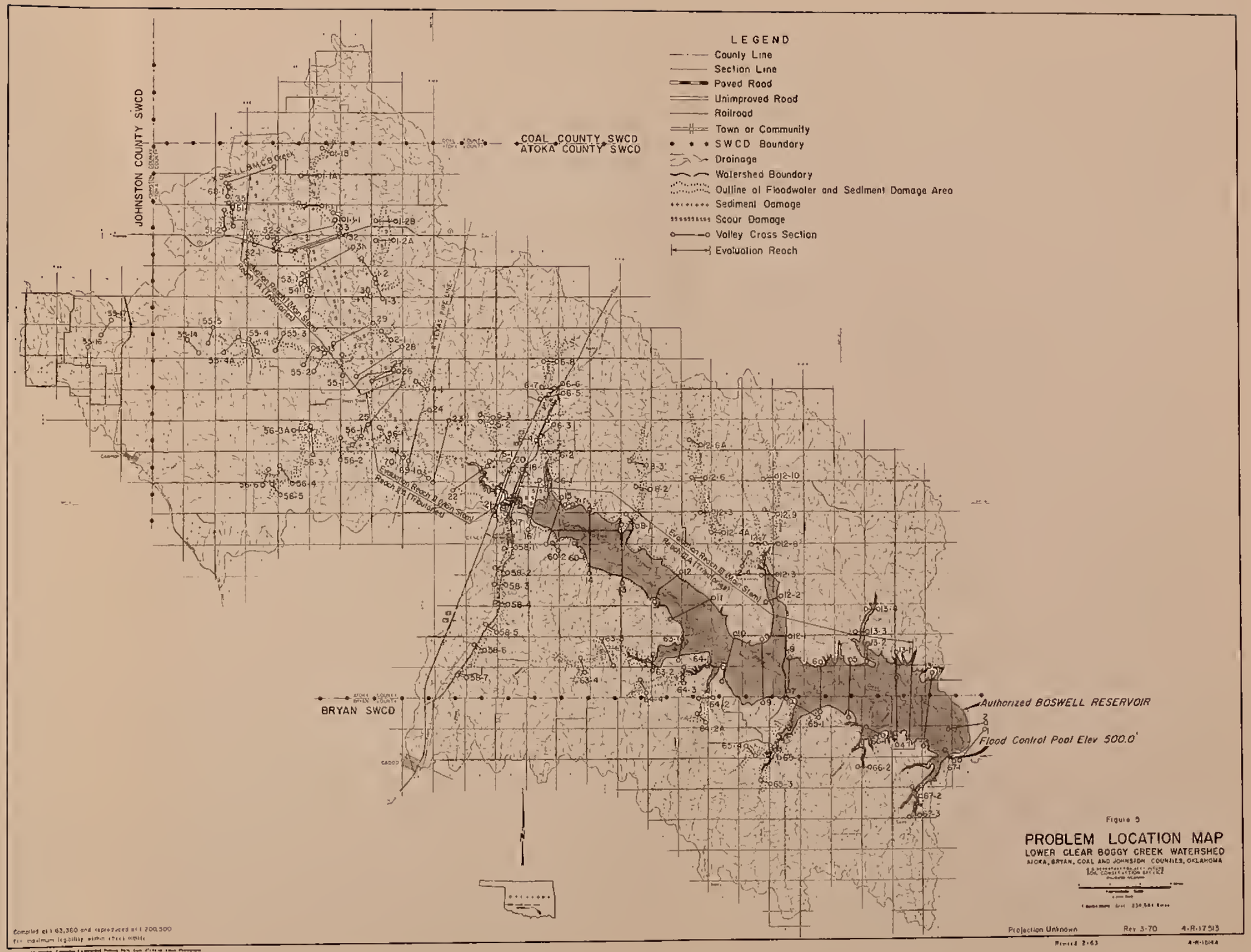


Figure 5

PROBLEM LOCATION MAP

LOWER CLEAR BOGGY CREEK WATERSHED

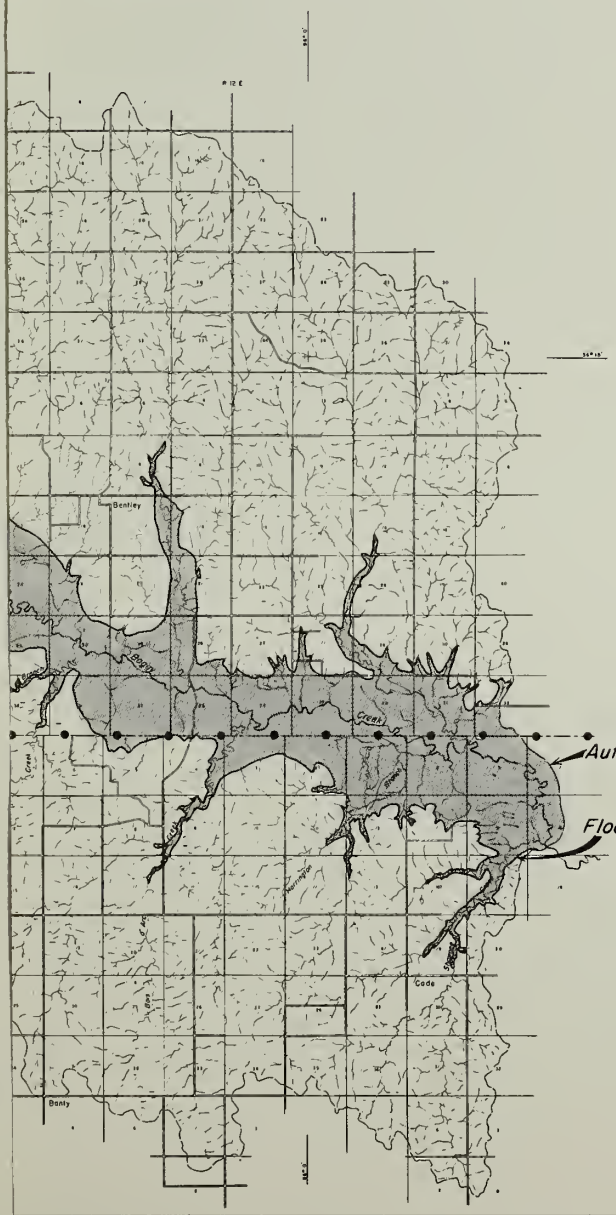
ATOKA, BRYAN, COAL AND JOHNSTON COUNTIES, OKLAHOMA

LEGEND

- County Line
- Section Line
- Paved Road
- Unimproved Road
- Railroad
- Town or Community
- S W C D Boundary
- Drainage
- Watershed Boundary
- Floodwater Retarding Structure
- Multiple Purpose Structure
- Drainage Area Controlled by Structure
- Area Benefited
- (6) Site Number
- Outlet Channels
- Diversion
- (-1) Channel Number

SITE NUMBERS AND DRAINAGE AREAS IN ACRES

No.	Area	No.	Area
4	1472	20	1715
5	1011	21	1990
6	384	22	2848
7	1517	23	429
8	1043	24	3040
9	4339	25	3411
10	4755	26	2445
11	1037	27	710
12	531	28	378
13M	16090	29	1299
14	2272	30	480
16	2784	31	5728
17	1594	32	5146
18	710		
19	717		



Authorized BOSWELL RESERVOIR

Flood Control Pool Elev. 500.0'

Figure 6

PROJECT MAP

LOWER CLEAR BOGGY CREEK WATERSHED

ATOKA, BRYAN, COAL AND JOHNSTON COUNTIES, OKLAHOMA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

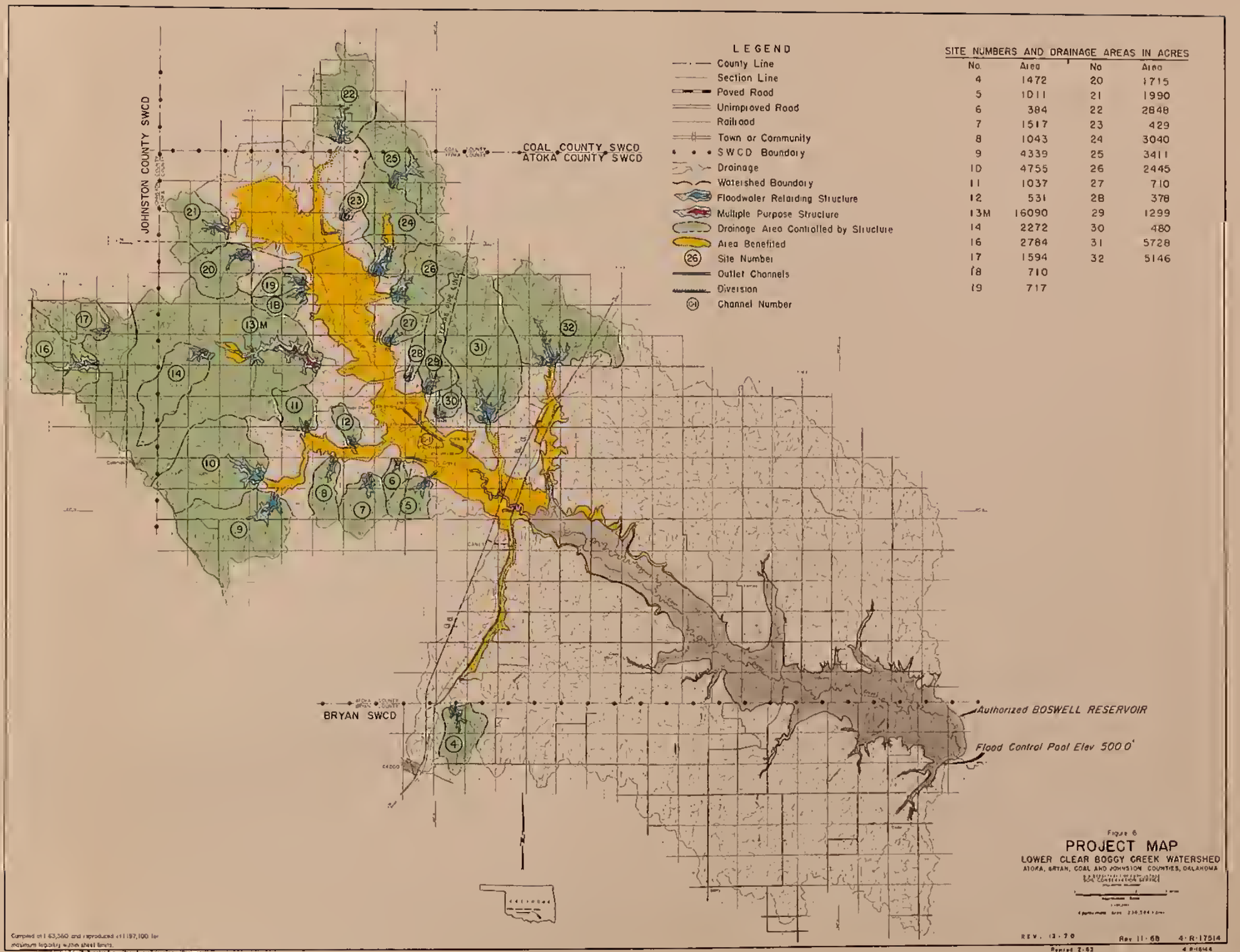
0 1 2 3 Miles

Approximate Scale
1:190,080

Approximate Area 234,584 Acres

REV. 13-70 Rev. 11-68 4-R-17514

Revised 2-63 4-R-16144


LEGEND
County Line
Section Line
Paved Road
Unimproved Road
Railroad
Town or Community
S W C D Boundary
Drainage
Watershed Boundary
Floodwater Retarding Structure
Multiple Purpose Structure
Drainage Area Controlled by Structure
Area Benefited
Site Number
Outlet Channels
Diversion
Channel Number
SITE NUMBERS AND DRAINAGE AREAS IN ACRES
No. Area No Area
4 1472 20 1715
5 1011 21 1990
6 384 22 2848
7 1517 23 429
8 1043 24 3040
9 4339 25 3411
10 4755 26 2445
11 1037 27 710
12 531 28 378
13M 16090 29 1299
14 2272 30 480
16 2784 31 5728
17 1594 32 5146
18 710
19 717
JOHNSTON COUNTY SWCD
COAL COUNTY SWCD
ATOKA COUNTY SWCD
BRYAN SWCD
Authorized BOSWELL RESERVOIR
Flood Control Pool Elev 500.0'
Figure 6
PROJECT MAP
LOWER CLEAR BOGGY CREEK WATERSHED
ATOKA, BRYAN, COAL AND JOHNSTON COUNTIES, OKLAHOMA
REV. 12-70
Rev 11-68
4-R-17514
Revised 2-62

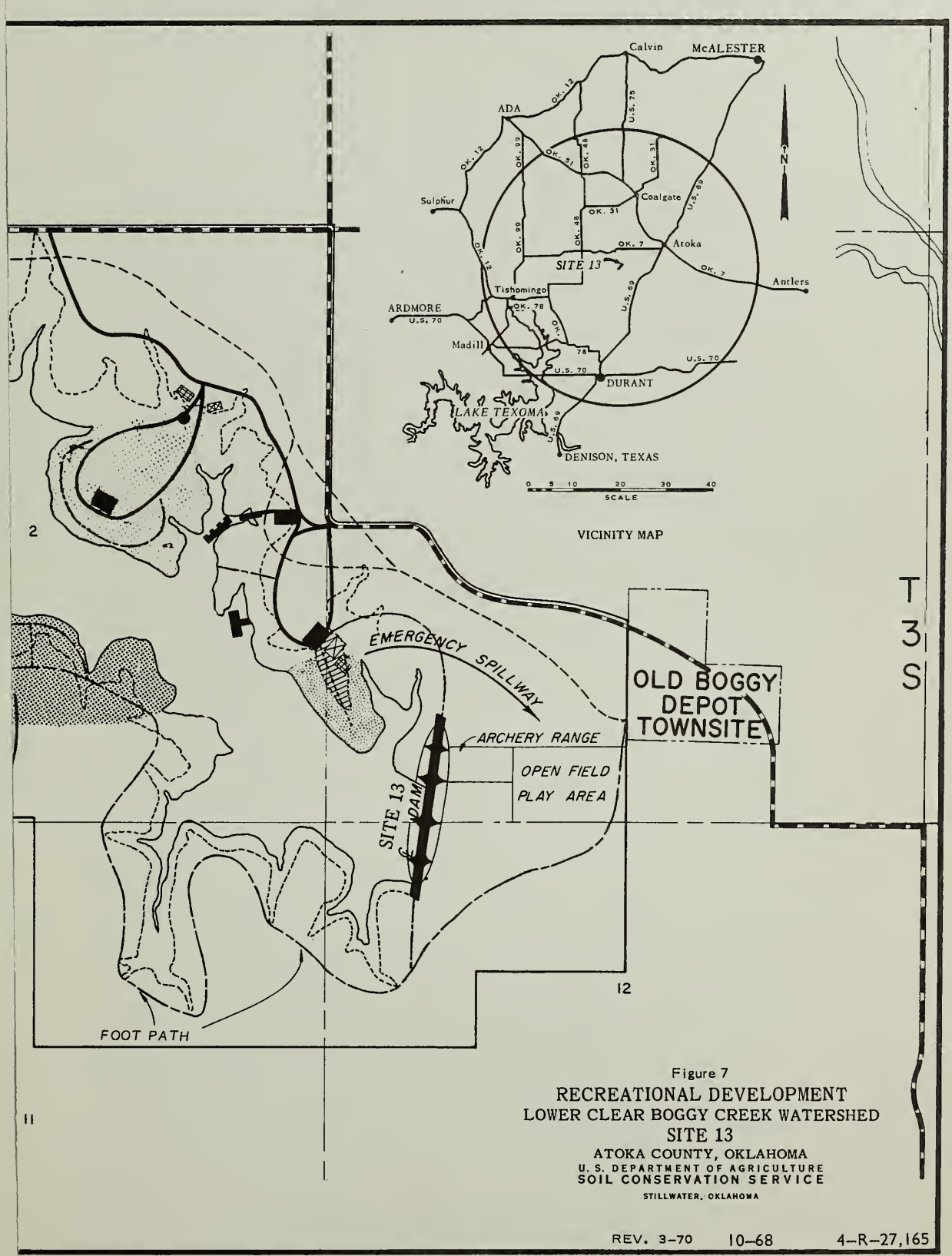


Figure 7

RECREATIONAL DEVELOPMENT
LOWER CLEAR BOGGY CREEK WATERSHED
SITE 13
ATOKA COUNTY, OKLAHOMA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

REV. 3-70 10-68 4-R-27,165

4-17920

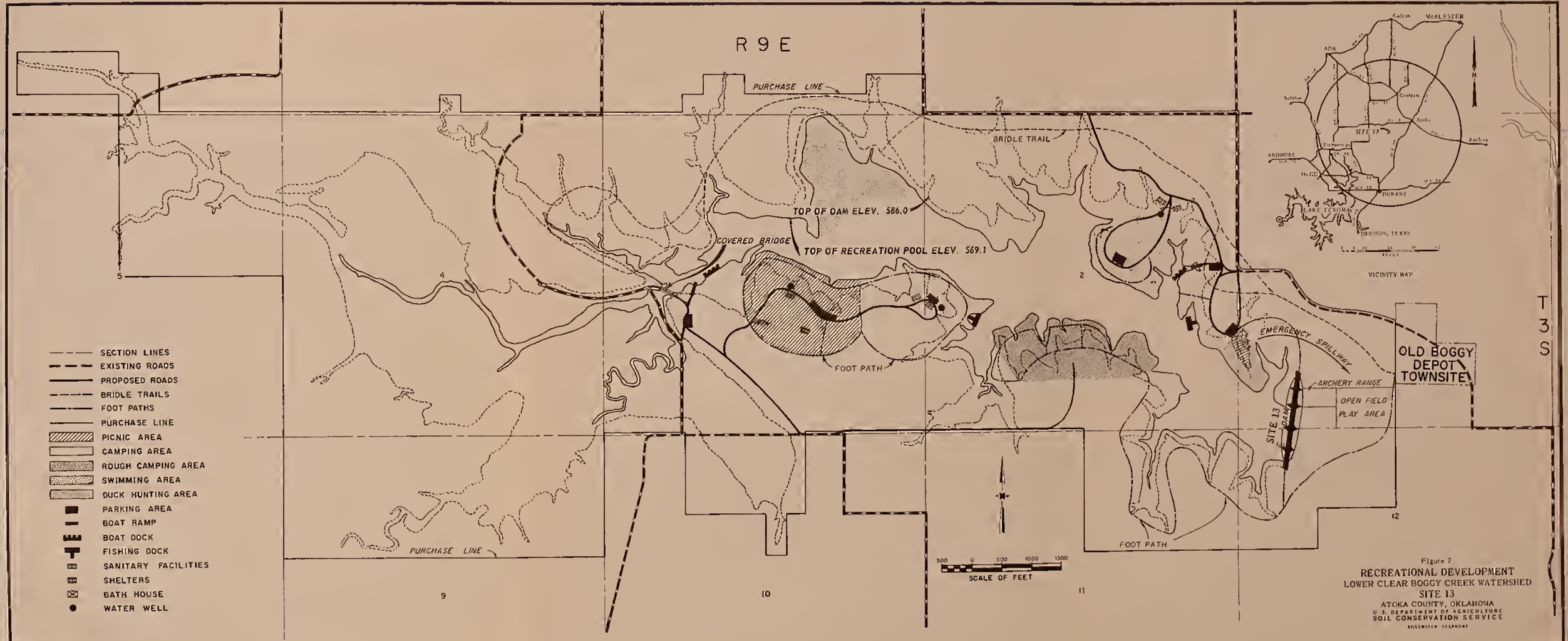


Figure 7

RECREATIONAL DEVELOPMENT
LOWER CLEAR BOGGY CREEK WATERSHED
SITE 13
ATOKA COUNTY, OKLAHOMA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
STILLWATER, OKLAHOMA

REV. 3-70 10-68 4-R-27,165

4-17920

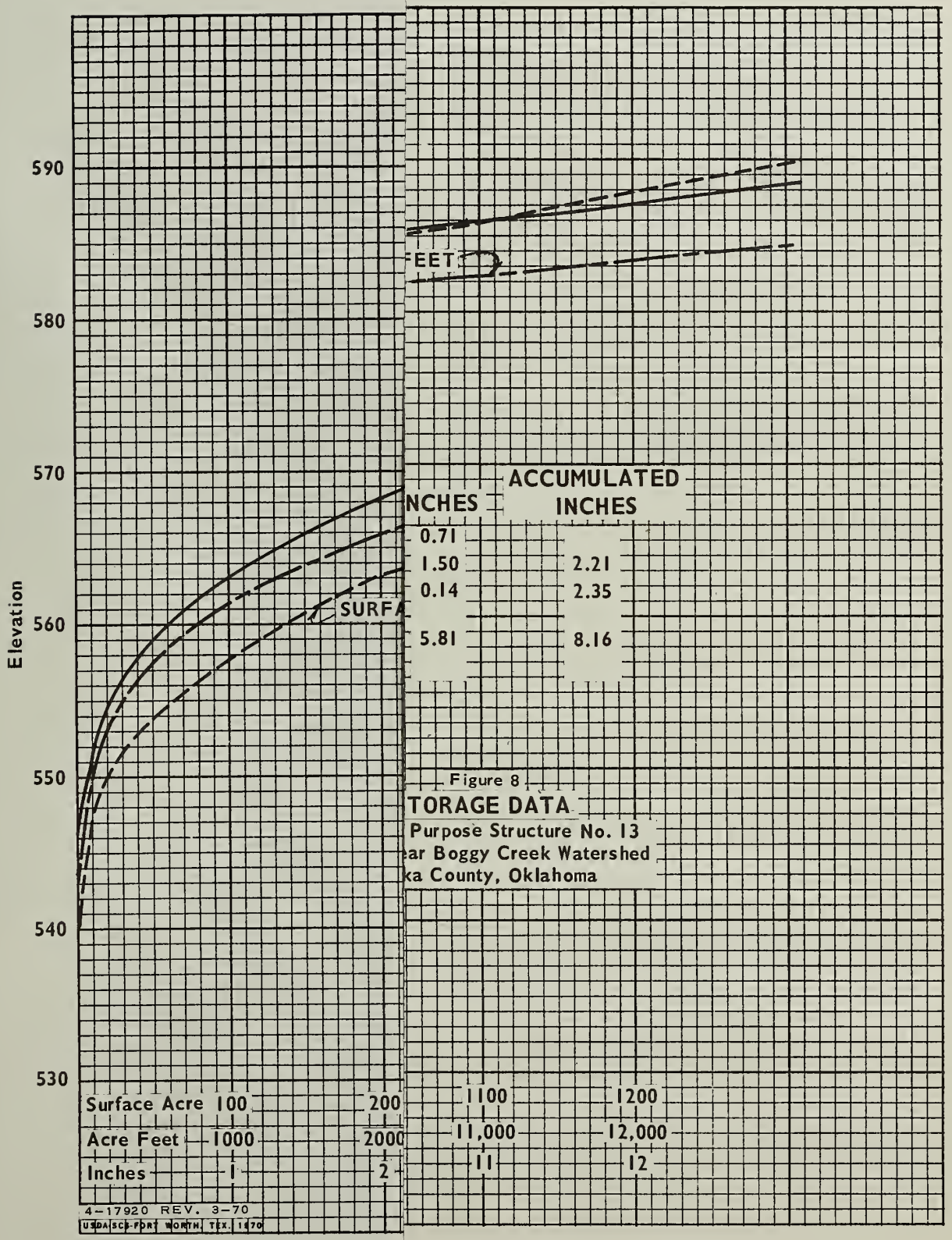


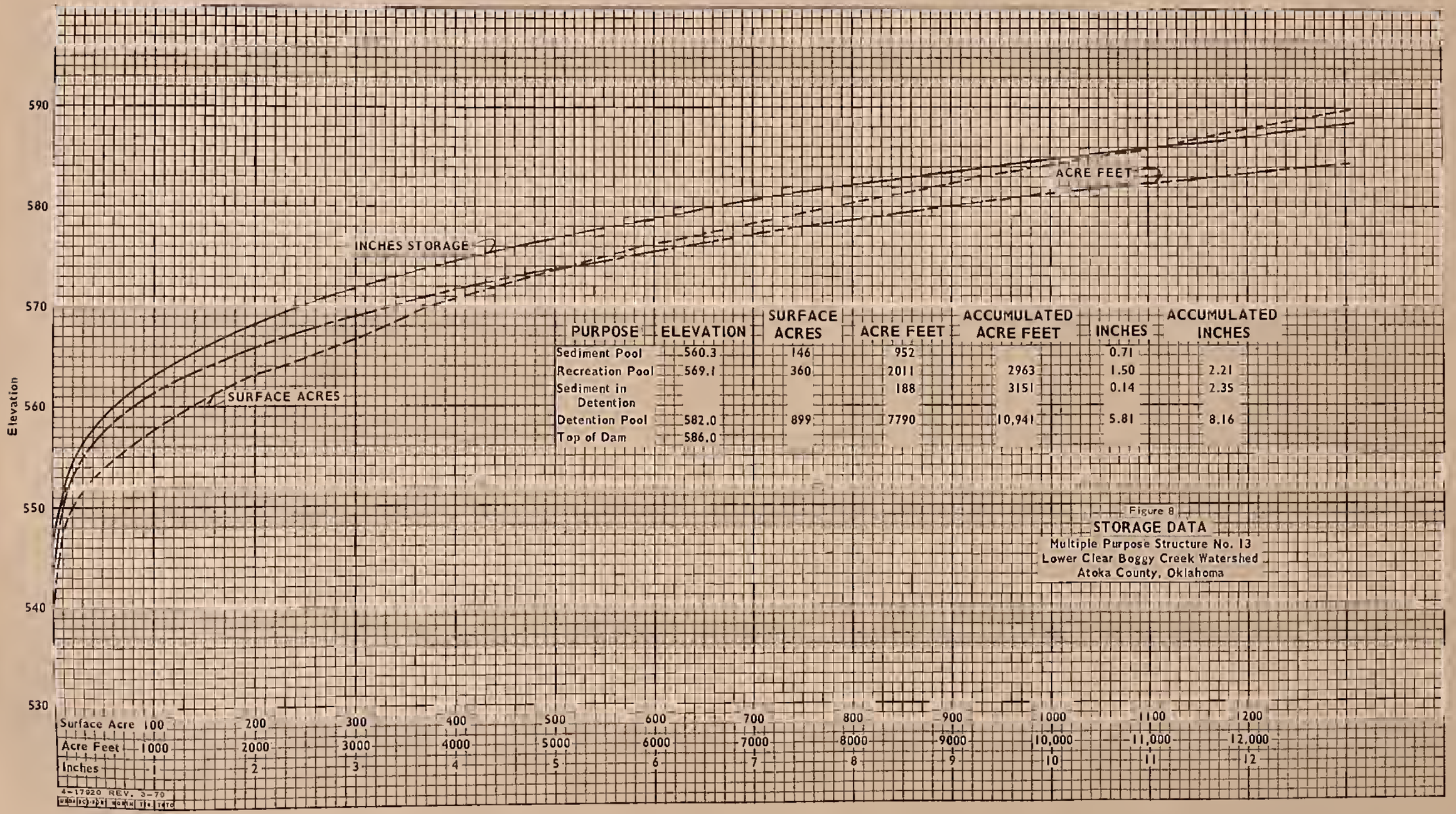
Figure 8

TORAGE DATA

Purpose Structure No. 13

ar Boggy Creek Watershed

ka County, Oklahoma



PURPOSE	ELEVATION	SURFACE ACRES	ACRE FEET	ACCUMULATED ACRE FEET	INCHES	ACCUMULATED INCHES
Sediment Pool	560.3	146	952		0.71	
Recreation Pool	569.1	360	2011	2963	1.50	2.21
Sediment in Detention			188	3151	0.14	2.35
Detention Pool	582.0	899	7790	10,941	5.81	8.16
Top of Dam	586.0					

Figure 8

STORAGE DATA

Multiple Purpose Structure No. 13
Lower Clear Boggy Creek Watershed
Atoka County, Oklahoma

4-17920 REV. 3-70

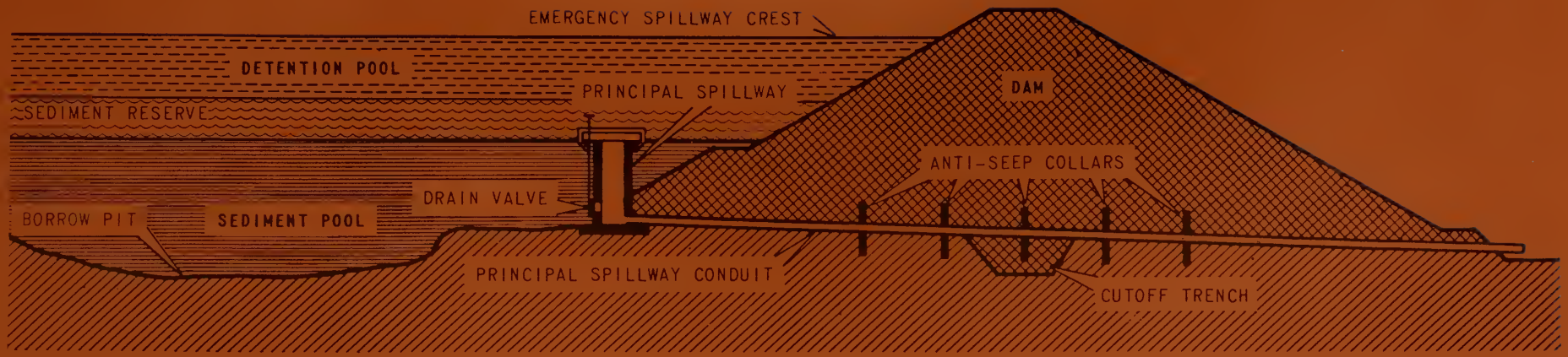


Plate I

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

2-65 4-L-19819